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AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 23 NOVEMBER, 1940 NUMBER 11

THE PHARMACOLOGICAL BEHAVIOR OF THE INTRAOCULAR MUSCLES*

I. THE PROBLEM OF SENSITIZATION, AND METHODS FOR ITS STUDY

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This is one of a series of papers in which the pharmacological responses of isolated strips of iris and ciliary muscles are to be reported and discussed. In this paper, certain fundamental concepts regarding "sensitization" of such responses by drugs and other agents are set forth; and with these concepts as a point of departure, the methods we have employed in this field are described in comparison and contrast to those hitherto in use. It is believed that with this fresh approach we avoid certain pitfalls and arrive at a more truthful expression of the behavioral characteristics of the reacting systems under various conditions.

By using the present contribution as an introduction, we may give in later papers more concrete experimental data, and avoid duplication of theoretical discussion. Our method of applying drug stimuli to the muscle preparations is described in the appendix.

THE UNIQUE CHARACTER OF IRIS RESPONSES

Studies of the behavior of a skeletal muscle under drug stimulation offer certain advantages—notably, the possibility of knowing the muscle tonus, and the applicability of the all-or-none law. When experimenting with smooth muscles, one lacks these aids. We need to develop methods which, despite this lack of "definiteness" in smooth-muscle behavior, will yield reliable quantitative information.

The peculiar behavior of iris muscles has forced us to take account of certain considerations that have not had attention in previous researches in smooth-muscle physiology. These considerations, applied to smooth muscles other than ocular, may be expected to make future studies more fruitful.

The iris muscles, unique in origin from ectoderm, are also unique in purpose. The responses of contraction and relaxation, as such, are the entire end of the activity. On the other hand, other muscles in the body contract in order to do mechanical work—to exert a force through a distance. In the regulation of the pupil it is distance alone that has significance. If the iris muscles overcome resistance by exerting appreciable force during their shortening, this is coincidental. Some factors in this possible resistance are the compressibility and elasticity of the blood vessels and stroma, friction between the iris and the lens capsule, and muscular antagonisms due to unprecise regulation of reciprocal contractions and relaxations of the sphincter and dilator. We cannot be sure that any of these resistances are

* From the Department of Ophthalmology, College of Medicine, Wayne University. Read before the Association for Research in Ophthalmology at New York, June 11, 1940.

present—certainly some of them at least would be active during only one movement, not in the opposite direction. The seepage of aqueous humor forward through the pupil may float the iris free of the lens capsule. There may be no effective muscular antagonism whatever.

Ordinarily, contraction of the iris muscles is an end in itself. But in the clinic, the demand may arise for a real work output. In breaking a synechia, it is more important to know the vigor than the amplitude of contraction.

We are usually content to know only the amplitudes of muscular contractions. But when we must try to estimate the relative strengths of the various available drugs, and to measure the changes of their apparent strengths produced by "sensitization," amplitude is not a sufficient criterion of the effort put forth by the muscle. We need to know the *amplitude* and the *load*—the distance and the force, in other words. We should, if possible, determine the speed of contraction so that we can speak not only of work but of work done per unit time; that is, power.

It is not enough, then, to determine that a given drug or combination produces a greater dilation of the pupil than some other. A wider dilation is not necessarily a stronger dilation. "Sensitization" may, as we shall see, yield increased amplitudes of contraction which are actually accompanied by a reduction of the work output of the muscle and a lessening of the amount of resistance against which the muscle will try to contract.

The nature of sensitization

As a pharmacological phenomenon, sensitization is an increase, produced by a drug or other agent, in the response of a biological system to a primary drug. As a special case, the unsensitized response to the primary drug might be zero. Here, we might speak of "qualitative" sensitization—the induction of a response to a drug which ordinarily is without effect. But most sensitizations (and the types with which we deal here) are quantitative.

Sensitization is customarily recognized when the minimal effective dose of a drug has somehow been lowered, or as Cannon (1939) puts it, when doses of the substance required to yield given submaximal responses are smaller than before. This says nothing about the nature of the sensitizing agent, which may be chemical (as, a drug), or physical (as, radiant energy), or may even be an abnormal complex, as for example in the denervation of the tissue to be tested.

Where the sensitizing agent is nonchemical, the sensitization may be described in Cannon's terms; but with drug sensitizations this is not always true. We tend to assume that when pretreatment with one drug makes possible a response to unusually low doses of a second drug, the threshold of the biological system has been lowered. Certainly this is often the case, as it always is when sensitization is effected by denervation. But our methods of testing do not differentiate between cases in which the change has taken place within the biological system (whether in cell membranes or cell contents) and those in which the "sensitizing" chemical has only activated the primary drug by promoting dissociation, decreasing surface tension, or the like. Strictly, we should reserve the term "sensitization" for induced alterations within the biological system; but until we know much more than we do about "points of attack" we shall have to continue to use the term in its present broad sense. But without knowing the points of attack of our drugs we still can (and must) recognize two distinct types of quantitative sensitization:

First ("threshold") type of sensitization

The usual procedure in the study of sensitization is to produce a standard amplitude or degree of contraction of the muscle, and compare the concentrations of drug X which yield this contraction, with and without a sensitizing drug Y. The extent of sensitization is then expressed by the lowering of the concentration of drug X. Now, drug Y is not necessarily one which can produce any contraction by itself, in any concentration.

When it does so, we cannot speak of sensitization until we have excluded mere summation. We might attempt this by reducing the concentration of drug Y until its single effect is negligible or zero —but at this concentration it might not have any sensitizing capacity. It is better simply to determine the single effect of that concentration of drug Y which we propose to use together with drug X. If the single effect of the latter is also known, we can then see readily whether the combined effect is greater than summation alone would explain. We must follow Cannon's dictum and keep both the single and combined responses submaximal.

Concept of the M.E.C.

Scaling downward the concentrations of drugs until their effects are submaximal is an unsatisfactory procedure. Actually, there is but one concentration of a given drug which, acting upon a given type of effector organ, has the attributes of a genuine standard. This is the concentration which yields a maximal effect. We find this by measuring amplitudes of contraction from increasing dosages, until a concentration is reached which, if increased, evokes no greater contraction. Our drug is now at maximal stimulating power under the given conditions, and its concentration is here designated the maximally effective concentration or "M.E.C." The contraction produced by an M.E.C. of one drug is of course not necessarily maximal for the muscle (for it is constant only for a given load) or identical with that given by some other drug whose strength is different.

When we know the M.E.C. for both drug X and drug Y, we may find that the M.E.C. of the sensitizing drug Y produces a contraction smaller than, equal to, or greater than that which drug X evokes in M.E.C. If it is anything but a smaller contraction, it becomes impossible to say which drug is the "sensitizer"—but this is a small matter, for the phenomenon of sensitization does not depend upon such designations.

What does matter, however, is whether the contraction to M.E.C. drug X plus M.E.C. drug Y is smaller than, equal to, or greater than that to either agent alone. If smaller, an antagonism within the combination is revealed—the inverse of sensitization. If the combined effect of the two drugs is no greater than that produced by drug X alone, it may appear that there is no sensitization, but in such cases it will be found that an equal effect can be obtained when drug X is at sub-M.E.C. concentration. In other words, the threshold to drug X has been lowered by drug Y, as we should see if we actually compared the sensitized and unsensitized thresholds in the usual way. Here, then, is a fundamental characteristic of the "threshold" type of sensitization partially described above—the threshold to drug X may be lowered by drug Y, but the response to M.E.C. of drug X cannot be increased by drug Y.

The second ("augmentative") type of sensitization

Our determination of M.E.C.'s and their employment in our experiments

have revealed not only the above situation in some drug combinations, but an entirely different situation in other cases, which we shall call *augmentative* sensitization. In the threshold type, the two drugs simply behave as though they were in a relay race. The greater the contraction produced by drug Y in a given concentration, the less contracting capacity remains to be evoked by drug X, and vice versa. The more one drug accomplishes, the less remains to be accomplished by the other since the total effect of the two represents no increase over the single effect of the more effective of the two.

The conspicuous feature of *augmentative* sensitization is that the response to the combination of drugs is greater than to either drug alone in M.E.C. The raised upper limit of response, in this type of sensitization, reveals that neither of the participating drugs is alone capable of developing a maximal contractive effort. Neither taxes the energy reserve of the responding muscle.

The smooth muscle as a quantitative recording system

It has been indicated above that differences in amplitudes of contraction alone cannot tell us the relative strengths of stimuli, chemical or otherwise. Yet as a criterion of a change in the mechanical activity of the muscle we can measure only amplitudes. We cannot measure them from any physiological zero, for the iris muscles (and all smooth muscles) have indeterminable tonus and are consequently of variable length when "unloaded." Neither length nor cross-sectional area is definite as with striated muscles. The all-or-none law may or may not hold for them. Even with "physiological" drugs such as adrenaline, we cannot subject them, either excised or *in situ*, to physiological stimulation by adrenaline if we apply it by artificial means; such as, by diffusion through the cornea or by immersing the excised muscles in a bath of the drug. We cannot take for granted that any or all of the cells of a muscle immersed in drug solution are actually exposed adequately to the solution. We cannot even take for granted that any one cell contracts homogeneously—especially if two different substances share in the production and maintenance of the contraction.

In the face of these difficulties, how can we make the contraction of smooth muscles under the drive of drugs a quantitative index of the relative strengths of those drugs and their combinations? Clearly, only by standardizing the concentrations of the drugs as M.E.C.'s, and measuring work outputs under known and various conditions of load which will standardize the effort of the muscle.

Work, power, and efficiency

If we know the load on a muscle and keep it constant, the output of mechanical work is the product of the load and the amplitude of contraction, and is directly indicated by the latter. The muscle may contract in various ways (by stages, with slight recessions, and so on), but the maximal amplitude reached furnishes a basis of comparison with some other contraction.

With a given work output, we do not necessarily have a fixed type of performance by the muscle. Both the power and the efficiency of the contraction may vary. If a muscle preparation lifts a small load through a great amplitude and a large load through a small amplitude, we can judge the true vigor of each performance only if we take *time* into consideration. The product of the amplitude and the load, divided by the time occupied in contracting, indicates the power of the

contraction. A small load is not only lifted farther, but also faster.

It would of course be desirable to know something of the *efficiency* of iris-muscle performances under different drugs and combinations, but this has not yet been attempted. The mechanical work done is only a portion of the total work of the muscle. The internal work done in the form of heat and the energy and entropy changes involved in chemical reactions remain concealed from us unless we install our whole apparatus in a supersensitive calorimeter. Even if we knew these values, however, we should need to know the food consumption of the muscle, expressed in heat or work equivalents, before we could compute efficiency as the quotient of total thermal and mechanical work output divided by input.

A CRITERION OF DRUG STRENGTH

Ordinarily, smooth-muscle contractions are studied without load other than the friction of recording apparatus (which the experimenter may or may not determine) or else with an arbitrary "small" load whose value is dictated by technical convenience rather than by considered theory. With striated muscles a load can easily be made small in terms of the cross-sectional area of the muscle, for this is a direct index of the muscle's strength. With smooth muscles, we find no definite cross-sectional area associated with a definite state of complete relaxation, and must consider as "small" any load which the muscle should be able to lift with a submaximal effort. The muscle may exert itself maximally, "wastefully," on this small load; but this is just what we cannot very well know, for it involves the applicability of the all-or-none law. Since it is always doubtful how seriously the muscle is taking its small task, performance under a small load tells only a part of the story. Under some particular drug, of course, the muscle might seem to strain at even this small load; but this would not mean that the load had become large—rather, that the drug in question was but weakly effective.

But contractions of equal amplitude against the same small load, under two different drugs or combinations—even if isochronous—may conceal important differences: the work output at one load can predict nothing as to the work output at a higher load. In the vernacular, under one drug the muscle may "quit" sooner, as the load is increased, than under another drug. This, of course, is a most practical consideration in the choice of drugs for therapeutic use. We might find that *power* outputs are closely similar against both low and high loads. But power is $\frac{\text{work}}{\text{time}}$, and time is an unimportant consideration in a clinical attack on synechia. It is the mutation of *work* output under a particular drug and a particular range of loads that counts.

We might express the strength of drugs in any of a dozen ways; but, obviously, the criterion we employ where the iris muscles are concerned must indicate the maximal load elevable by the muscle under the given drug, and also the "staying power" of the stimulus-response system under increasing load.

Figure 1 sets forth these considerations graphically. If under M.E.C. stimulation with a given drug, a muscle preparation lifts a low load to amplitude A_L and a high load to amplitude A_H, then the quotient A_H/A_L can tell us a great deal. In the first place, our high load is naturally chosen as one which the muscle can always manage to raise. It is therefore not the *maximal* elevable load, for to determine the latter for a single preparation by trial and error would be impossible—the preparation would not hold

up long enough. Fortunately, it is not necessary to determine the limiting load directly. We need only prolong the graph with which amplitude falls off as, with increasing load, the effectiveness of the drug in developing contraction decreases.

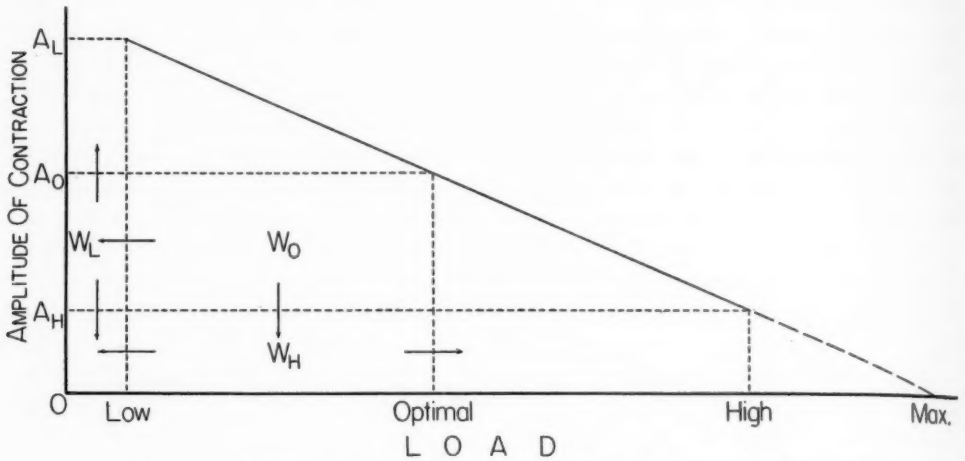

Fig. 1 (Sachs and Heath). Diagrammatic representation of load-amplitude relationships and work-output areas.

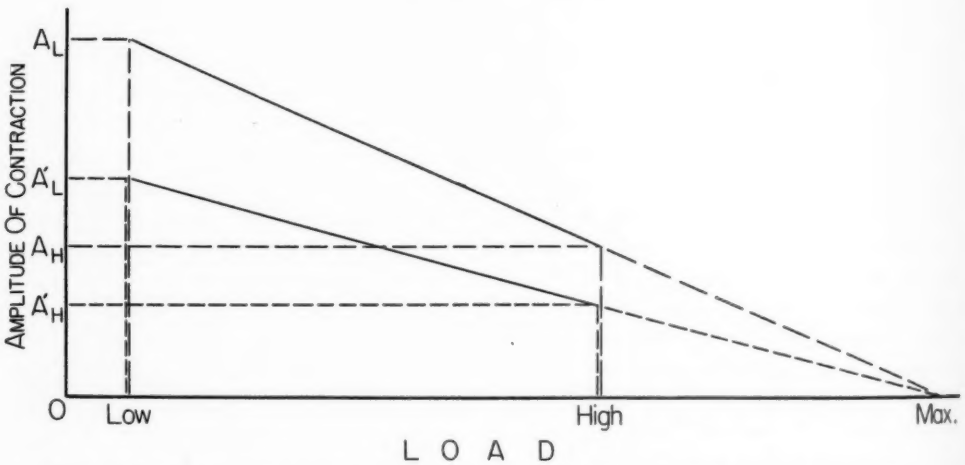

Fig. 2 (Sachs and Heath). Diagrammatic representation of individual variation of muscle strips in response to low and high loads, showing constancy of the high-low amplitude quotient and of the predicted maximal elevable load.

of load vs. amplitude until it cuts the abscissa, and thus obtain by extrapolation the maximal elevable load (actually, the just-*not*-elevable load).

The ratio, or quotient, A_H/A_L determines where this point will be. At the same time, it expresses the *slope* of the graph, and is thus an index of the rapidity This "high-low amplitude quotient" is thus the criterion of drug strength we have been seeking. Its complete validity depends naturally upon the existence of a rectilinear relationship of load and amplitude.

It needs pointing out that when the maximal elevable load is being lifted, the

mechanical work being done is *not* maximal. Such a load stretches the muscle greatly, and we know from the work of Brocklehurst (1926) on the cat ileum that there is an optimal length from which a smooth muscle will contract with a maximal work output. In figure 1, W_L is a tall, narrow area representing the work done on the low load. The low, broad area, W_H, expressing the work done on the high load, is not much greater. The *optimal* load, at which the work-area W_0 is the largest area which can be fitted under the graph, is an intermediate value. With this load, a contraction of amplitude A_0 would be obtained.

In figure 2 is represented a corollary which must hold if our amplitude quotient is to serve as a valid criterion of drug strength. If the two graphs shown represent the extremes of individual variation in the performance of a series of muscle preparations, they must aim at the same extrapolated maximal load. The graphs these preparations plot must swing about this point on the abscissa as a pivot; for A_H/A_L must be equal to $A_{H'}/A_{L'}$ according to the law of the proportionate division of the bases of similar triangles. This corollary, again, must be established experimentally before the amplitude quotient can be finally accepted.

Figure 3 shows what we may then expect as a graphic demonstration of the relative strengths of different drugs when used in M.E.C. on the same reacting system. Drug X evokes an amplitude of A_X at a low load, and the relatively low amplitude at the high load extrapolates the maximum elevable load $Max._X$. The slope of the graph of drug Y is quite different, and indicates a much higher maximal load $Max._Y$. According to the hitherto customary mode of expressing drug strengths, drug X would be called the "stronger" of the two since the muscle under its influence lifts a small load to a greater amplitude. But in the light of our new criterion, we readily see from figure 3 that it is drug Y which is really the more effective in developing performance against high resistance—which is what we want in a therapeutic application of drugs to the iris. Drug Z appears equal in "strength"—according to usual criteria—

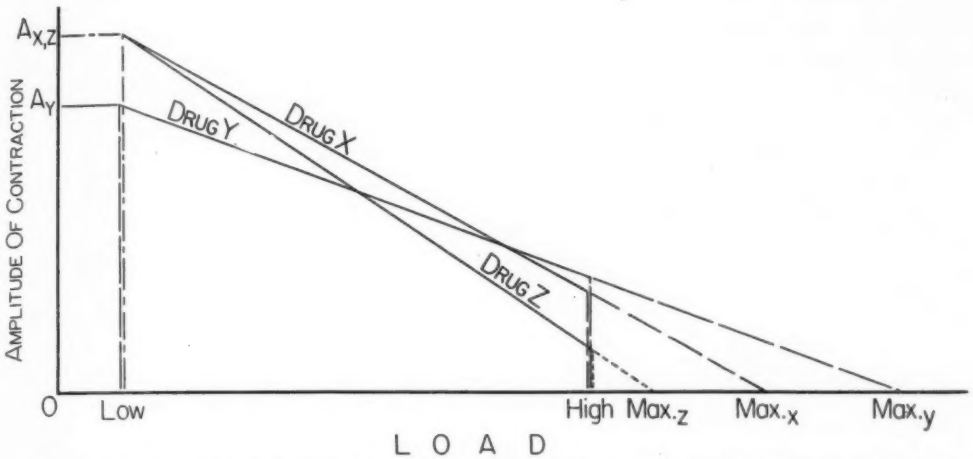

Fig. 3 (Sachs and Heath). Relative strengths of drugs as revealed by their high-low amplitude ratios and predicted maximal elevable loads, despite contradictory "indications" from performances under low loads.

to drug X; but performance under it falls off rapidly indeed. We shall consider some drugs and combinations which produce such results, in the next paper of this series.

The dilator under adrenaline stimulation

To illustrate the principles expounded in the above discussion, let us consider the behavior of dilator strips (albino rabbit) under adrenaline. In preliminary experiments, the maximally effective concentration was found to be 1:500,000. Either this concentration or 1:333,333 was always used.*

The relationship of load to amplitude was determined by testing the same strip at 20-mg., 60-mg., 100-mg., and 140-mg. (or 144-mg.) loads, washing the strip between tests. The results are given in table 1:

TABLE 1

Load-amplitude relationship, adrenaline-dilator system

Load mg.	Amplitude, Scale Units	
	Strip 1	Strip 2
20	1.20 1.15*	0.95
60	0.95	0.60 0.70*
100	0.55	0.45
140	0.35	
144		0.15

* Retests, to check reproducibility, made after completion of series.

These values are plotted in figure 4, from which it may be seen that the relationship is indeed linear over the range of loads employed. Hence, for the determination of such graphs in the principle experiments, it was sufficient to test each strip under only two loads, respectively low (20 mg.) and high (140 mg.). Incidentally, it was found that the order of application of the loads was of no consequence.

The variability of different dilator strips under these two loads and M.E.C. adrenaline was then studied, to determine the average high-low amplitude quotient (our criterion of drug strength) and to check upon the convergence of all graphs toward the same extrapolated maximal elevable load. The results on 16 strips of tissue are given in table 2 and figure 5.

TABLE 2

Variability of 16 dilator strips under adrenaline

Amplitude, Scale Units		High-Low Amplitude Quotient	Distribution
20-mg. load	140-mg. load		
2.80	0.20	.072	0–.100(1)
1.10	0.15	.136	
0.90	0.15	.167	.110–.200(3)
1.35	0.25	.185	
0.95	0.20†	.210*	
1.40	0.30	.214*	
0.65	0.15	.230	
1.25	0.30	.240	
1.20	0.30	.250*	.210–.300(8)
1.15	0.30	.260*	
2.20	0.60	.272	
1.05	0.30	.285	
1.75	0.60	.343	
1.00	0.35	.350*	.310–.400(2)
1.40	0.70	.500	.410–.500(1)
0.65	0.35	.540	.510–.600(1)

* Adrenaline 1:333,333; all others, adrenaline 1:500,000.

† Extrapolated value—actual load was 120 mg.

From table 2 it is seen that the various strips yield a normal distribution with half of them falling in the modal range 0.210 to 0.300. The average quotient for this modal group, 0.245, may be taken as the index of the strength of adrenaline as a stimulus to the dilator under the conditions of the experiment. These conditions of course include the width of the strip of tissue used, which, in our experiments, is fixed by the width of our clamps and

* Where a drug is nontoxic, it can of course be used at M.E.C. or at any higher concentration—indeed, no *exact* M.E.C. is ever determinable, so one "plays safe" in this way.

is constant. A strip twice as wide could not lift a low load twice as high (since percent shortening is a function of length, not of width); but it would lift twice as great a "maximal elevable" load, and would raise a 140-mg. load proportionately higher than a 20-mg. one. The high-low amplitude quotient for a given drug and a given strip of tissue will thus vary with the width of the latter if this value is allowed to vary.

Figure 5 reveals that the various strips do indeed "aim" at the same value of maximal elevable load, the variation in this extrapolated value being molded by the variation, from strip to strip, in the high-low amplitude quotient. The average value of the latter (.245) predicts a

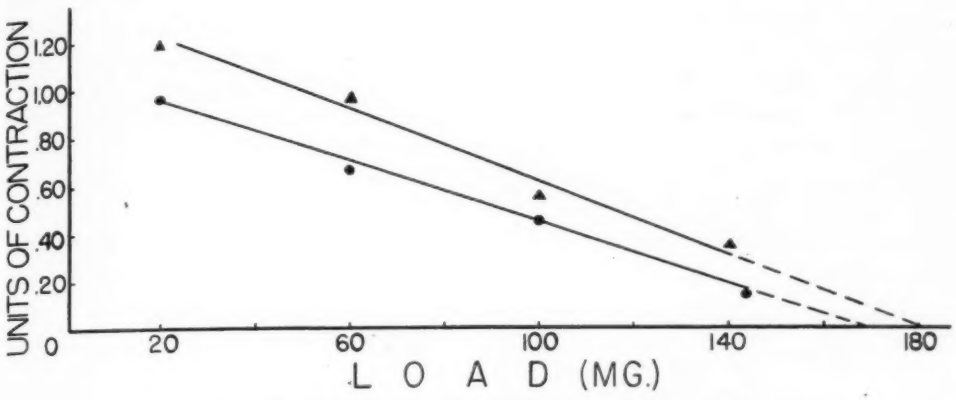

Fig. 4 (Sachs and Heath). Load-amplitude relationships of two albino-rabbit dilator strips under 1:333,333 adrenaline.

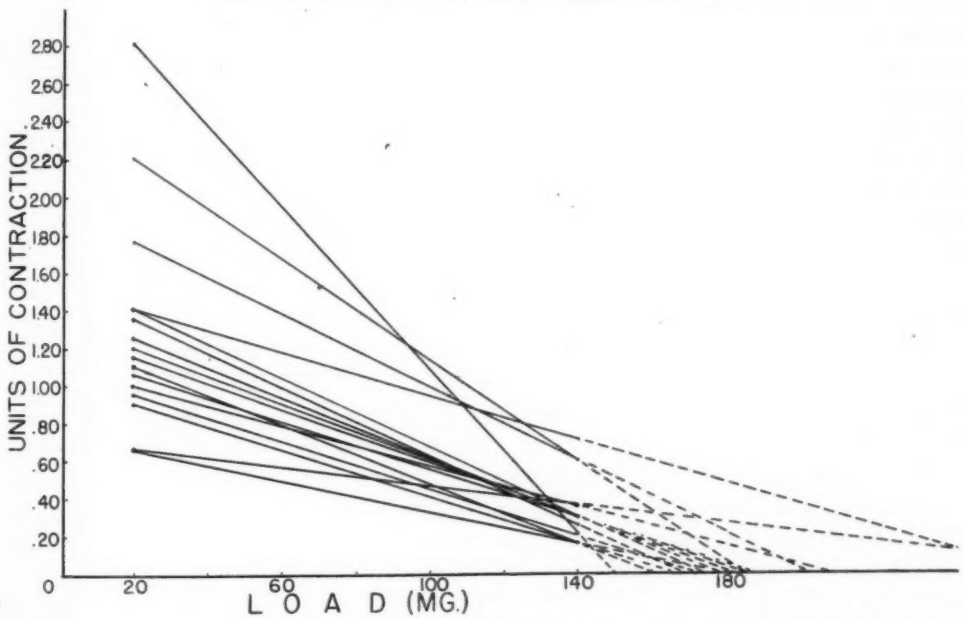

Fig. 5 (Sachs and Heath). Load-amplitude graphs of 16 albino-rabbit dilator strips under adrenaline, with low and high loads. Explanation in text.

maximal load of about 180 mg.

We wish to stress the fact that the variability shown in figure 5 is of strip-to-strip character. Any one strip, we find, repeats its performance closely. Again, the apparent greater variability of performance under low load than under high, is *only* apparent—the percent variations are about the same. What this indicates is that each strip, under adrenaline, *does* take the task of lifting the small load just as seriously as the bigger job at 140 mg.

Appendix

Technique. Albino rabbits were used, since the neuro-histology of the iris of this animal is well known (see Kirpitchowa-Leontovich, 1911). The method of preparing the strips of iris tissue was that used by Heath and Geiter (1939), following Poos (1927). The holding and recording apparatus has been described by Heath and Sachs (1940).

Essentially, the apparatus holds the ends of the strip in tiny (64.5-mg.) clamps. The lower clamp is attached by a silk thread to an anchorage. Its weight thus hangs on the muscle, which itself weighs about 2 mg., but this dead weight is constant and is negligible since, despite it, a counterbalance is necessary to straighten out the preparation even before a 20-mg. load is applied to the counterweight. The pulley of the recording device, over which the thread from the upper clamp runs to the counterweight, is jewelled and practically frictionless. Since the muscle pulls against a free weight, equal increments of shortening indicate, directly, equal increments of mechanical work.

The temperature of the Sollmann-Rademaeker solution surrounding the muscle was kept at 33°±0.2C., the pH at 7.5±0.1. The drugs were added to the muscle chamber through a right-angled cannula* with a horizontal part 3 inches long, a vertical portion 12 inches long, and an internal volume of 0.2 c.c. When in position for an injection, the horizontal limb rests against a wire stop with the vertical limb passing through a guide, so that the site of admission of the drug is constant. The speed of injection affects the distribution of the drug solution in the chamber fluid, and was standardized as follows: With the syringe filled with methylene blue, the plunger was moved in and out steadily several times, until the dye was spread homogeneously and reached the fluid surface. This situation obtained within 15 to 20 seconds with three round trips of the plunger. The drugs were injected in this same manner. The muscle strip was kept immersed close to the surface,** and the large volume (200 c.c.) of the muscle chamber insured against any great change of fluid level, or agitation of the muscle, during manipulation of the syringe. In our procedure the drug solution in the syringe was always made up to 1.0 c.c., in a concentration which, after injection and distribution, would yield the desired concentration impinging promptly upon the muscle. Whether one or several drugs were added and mixed, an equal volume of fluid was drawn up into the syringe after the last mixing-movement of its plunger. Care was always taken to remove any load greater than 20 mg. from the muscle during a change of the chamber fluid between tests, thus avoiding any sudden strain on the preparation. By observing these various precautions, we believe that

* Kindly obtained for us by Dr. F. F. Yonkman—made expressly for this work by Becton, Dickinson and Company.

** To insure adequate oxygenation. Aëration during the progress of experiments would have been disturbing (particularly with adrenaline) so the Sollman-Rademaeker stock-bottle was aërated before the muscle chamber was filled. No signs of anoxia were ever seen.

we have eliminated the avoidable inexactitudes, and standardized the unavoidable ones, in the procedure of drug application.

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PASSAGE OF HORSE SERUM FROM THE BLOOD STREAM INTO THE AQUEOUS HUMOR OF NORMAL AND IMMUNIZED ANIMALS*

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The eye has long been used as a site for immunological studies. In 1908 Nicolle and Abt[1] found that if rabbits were given intraperitoneal injections of horse serum in sufficient quantities to produce anti-horse-serum precipitins, violent ocular inflammation resulted when the anterior chambers were injected with horse serum. This inflammation was greater than that produced by the injection of horse serum into the anterior chambers of normal rabbits. Sattler[2] in the following year (1909), working independently, confirmed this observation. He immunized rabbits with serums from cattle, cats, guinea pigs, dogs, and goats and then injected the vitreous with the serum to which they were immunized. A greater and prompter reaction occurred than in normal animals, and Sattler thought that it was an anaphylactic phenomenon. Homologous serum, injected into rabbits, produced no reaction other than that due to trauma. Immune serum produced no more reaction than nonimmune serum. Kummel[3] in 1910 reported that injection of human serum into the vitreous of rabbits produced general sensitivity to human serum; he found that, conversely, the eye took part in the general sensitivity produced by intravenous and subcutaneous injections. The vitreous humors of some of his rabbits were injected with human serum. After an interval of five or more weeks, the initial inflammation having subsided, human serum was injected intravenously. A toxic general reaction followed and was accompanied by inflammation of both eyes. This reaction led Kummel to conclude that intravenous or subcutaneous injection of a protein could sometimes cause a flare-up of an iridocyclitis which had previously been caused by a single injection of the protein.

In 1930 Seegal and Seegal[4] injected a protein such as guinea-pig red blood cells and egg albumen into the anterior cham-

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ber of the right eyes of a group of rabbits and after two or more weeks injected the same protein intravenously. A reaction appeared in the treated eye which was characterized by congestion of the pericorneal vessels and by hyperemia of the iris. This was most intense after five hours and subsided within about 24 hours. It was shown to be specific for the protein used in the initial injection. The contralateral eye, which was used as a control, reacted slightly in a small number of instances. The fact that a period of at least five days was required for the production of this local sensitivity led Seegal and Seegal to consider the phenomenon an antigen-antibody reaction.

Following injection of crystalline egg albumen, precipitins were found by Thompson, Gallardo, and Khorazo[5] in the cornea, sclera, and sometimes in the uveal tract, but none were demonstrable in the aqueous. Except for the recent work of Bennett and Shaffer[6] there is little information on the passage of protein or antigen from the blood stream into the aqueous. To learn the conditions that determine the passage of foreign protein from the blood stream into the aqueous, the following experiments were performed.

Material and methods

Healthy, adult male and female albino and chinchilla rabbits that weighed between 1,800 and 2,800 gm. were used. The eyes were anesthetized by the use of 2 drops of 2-percent butyn at a 2-minute interval. Exposure of the eye was obtained by a small wire lid retractor. Short, beveled no.-26 intradermal needles were well suited for aspiration of aqueous and injection into the anterior chamber. Standard tuberculin syringes were employed, as they were convenient to handle and facilitated measurements. Before an injection was made into the anterior chamber, a volume of fluid equal to that which was to be introduced was withdrawn from the aqueous in order to minimize disturbance in intraocular tension.

Whole horse serum was the protein selected for these experiments because of its availability and because it is not so rapidly excreted through the kidneys as are many other proteins.

Antibodies against horse serum were obtained from rabbits that had received intravenous injections of 1.0 c.c. to 2.0 c.c. of horse serum every 5 or 6 days until the precipitin titers were elevated to 1:125,000.

The presence of horse serum in the anterior-chamber fluid was determined by means of the precipitin test. Since the amount of anterior-chamber fluid available from each aqueous was seldom more than 0.25 c.c., it was necessary to perform the precipitin test with small quantities of fluid. The aqueous fluid containing the antigen was diluted as follows: 1:2, 1:4, 1:8, 1:16, 1:32. The rabbit serum containing antihorse-serum precipitins was diluted 1:5 with normal saline. Of each dilution of aqueous, 0.1 c.c. was added to 0.3 c.c. of rabbit serum. The tubes were placed in an incubator at 37°C. for two hours and in an icebox overnight. The tests were read on the following day, and the results were recalculated to correct for the serum dilution. The interval of five hours was allowed to elapse between intravenous injection and aspiration of the aqueous because the inflammatory reaction noted by the Seegals was at its height at that time. Two weeks was the time allowed for local sensitivity to develop in injected eyes.

Experiments

Experiment 1. A group of 10 rabbits was injected intravenously with 2.0 c.c.

of normal horse serum, and after five hours the aqueous of each eye was aspirated. The amount of horse serum present was determined by the precipitin test. No horse serum was detected in the aqueous of any of these animals (table 1). A trace of horse serum was present in the aqueous in only 1 of 4 rabbits that had received 4.0 c.c. intravenously five hours previously. In 3 of 5 rabbits that had received 5.0 c.c. of horse serum intravenously, five hours before the aqueous was aspirated, horse serum was found in the aqueous. All of 4 rabbits receiving 6.0 c.c. of horse serum intravenously showed the horse serum present in the aqueous after five hours.

This experiment shows that quantity, or concentration, of a foreign protein in the general circulation is a factor influencing its penetration into the anterior chamber.

Since horse serum was not found in the aqueous of any normal animal that received less than 4.0 c.c. intravenously, 2.0 c.c. was selected as a quantity suitable for the demonstration of horse serum in the aqueous of previously immunized animals.

Experiment 2. The permeability of horse serum from the blood stream into the anterior chambers of rabbits, each of which had previously received an injection of horse serum into one anterior chamber, was studied.

TABLE 1

APPEARANCE OF HORSE SERUM IN THE AQUEOUS FIVE HOURS AFTER ITS INTRAVENOUS INJECTION

Quantity of Horse Serum Injected (c.c.)	No. of Rabbits	No. of Rabbits in Which Horse Serum Appeared in Aqueous
2	10	0
4	4	1
5	5	3
6	4	4

TABLE 2

PRECIPITIN TITERS OF HORSE SERUM IN AQUEOUS HUMOR OF PREVIOUSLY TREATED AND OF UNTREATED EYE AFTER INTRAVENOUS INJECTION OF HORSE SERUM

Number of Rabbit	Treated Eye (Right)	Untreated Eye (Left)
1	1:80	1:40
2	1:40	1:20
3	1:40	1:20
4	1:40	1:10
5	1:20	1:20
6	1:10	1:10
7	1:10	trace
8	1:10	0
9	0	trace
10	0	0
11	0	0
12	0	0
13	0	0
14	0	0
15	0	0
16	0	0

Each of 16 rabbits received 0.15 c.c. of whole horse serum in the anterior chamber of the right eye. The blood serum of 8 of these rabbits was tested for precipitins two weeks after the injection, and none were demonstrated. At this time, 2.0 c.c. of horse serum was injected intravenously, and after five hours the aqueous humor of each eye was aspirated and tested by the precipitin test for horse serum. Following the intravenous injection, the eyes that had been injected with horse serum exhibited an acute inflammatory reaction similar to that described by Seegal and Seegal.[4] The intensity of the reaction was approximately the same in all animals, but the quantity of horse serum detected in the aqueous varied. It was present in amounts of 1:10 to 1:80 in the right eye in 8 of the 16 rabbits. In 7 of the 8 animals that had horse serum in the treated eye it was also present in the untreated eye, but in less concentration (table 2).

This experiment indicates that following a local change brought about by the injection of horse serum into the anterior chamber of an eye, penetration of horse

TABLE 3

PRECIPITIN TITERS OF HORSE SERUM IN THE AQUEOUS HUMORS OF IMMUNIZED RABBITS FIVE HOURS AFTER THE INTRAVENOUS INJECTION OF 2.0 C.C. OF HORSE SERUM

Number of Rabbit	Antihorse-Serum Precipitin Titer in Blood Stream	Titer of Horse Serum in the Aqueous of the Two Eyes	
		Treated Eye (Right)	Untreated Eye (Left)
1	1:125,000	1:40	1:40
2	1: 75,000	1:40	1:20
3	1:125,000	1:40	0
4	1: 75,000	0	1:20
5	1:125,000	0	0

serum from the blood into the aqueous is facilitated. This happens to both eyes, but is most marked in the eye that received the local injection. It has not been possible to demonstrate that it depends on the formation of antihorse-serum precipitins in the blood or the aqueous.

Experiment 3. Five rabbits were injected intravenously with 2.0 c.c. of horse serum and 10 days later reinjected with 1.0 c.c. A week after the second injection the rabbits were bled and the antihorse-serum precipitins were determined. They were found to range from 1:75,000 to 1:125,000. Two cubic centimeters of horse serum was then injected intravenously and after five hours the aqueous of each eye was aspirated and tested for the presence of horse serum. Horse serum was found in both eyes of two rabbits, in the right eye of one and in the left eye of another. In one rabbit none was detected in either eye (table 3).

When a similar amount (2.0 c.c.) of horse serum was injected intravenously into normal rabbits, none appeared in the aqueous. The results of this experiment when compared with those of experiment 1 (table 1) indicate that immunization with horse serum facilitates the passage of subsequent intravenous injections of horse serum from the blood into the aqueous.

Experiment 4. Seventeen rabbits received 1.0 to 2.0 c.c. of horse serum intravenously at 5- or 6-day intervals until precipitins against horse serum reached a titer of 1:25,000 or higher. Each rabbit then received 0.15 c.c. of horse serum into the anterior chamber of the right eye. Following this injection, the eyes reacted more intensely than did those of normal rabbits. Nevertheless, after two weeks, the eyes of the immunized animals had apparently returned to normal.

After this interval of two weeks all the rabbits received an intravenous injection of 2.0 c.c. of horse serum and five hours later the aqueous humor was withdrawn from the anterior chamber of each eye. This fluid was tested for horse serum by the precipitin test. In 15 of the 17 animals horse serum was demonstrable in the aqueous from the right, or previously treated eye. In eight of these same rabbits horse serum was demonstrable in the un-

TABLE 4

PRECIPITIN TITERS OF HORSE SERUM IN AQUEOUS HUMOR OF IMMUNIZED RABBITS FOLLOWING INTRAVENOUS INJECTION OF HORSE SERUM TWO WEEKS AFTER THE PRODUCTION OF INFLAMMATION BY INJECTION OF HORSE SERUM INTO ONE EYE

Number of Rabbit	Antihorse-Serum Precipitin Titer in Blood Stream	Titer of Horse Serum in the Aqueous of the Two Eyes	
		Treated Eye (Right)	Untreated Eye (Left)
1	1: 40,000	1:160	1:80
2	1:125,000	1: 80	1:80
3	1: 50,000	1: 80	1:20
4	1: 75,000	1: 80	1:20
5	1: 40,000	1: 80	0
6	1: 25,000	1: 40	1:20
7	1: 50,000	1: 40	1:10
8	1: 50,000	1: 40	0
9	1: 75,000	1: 40	0
10	1:125,000	1: 40	0
11	1:125,000	1: 20	1:20
12	1: 75,000	1: 20	1:10
13	1: 75,000	1: 20	0
14	1: 50,000	1: 10	0
15	1:125,000	1: 10	0
16	1:125,000	0	0
17	1:125,000	0	0

treated, contralateral eye. Horse serum was present in the previously treated eye in greater quantity than in the control eye in all animals except rabbits 2 and 11 (table 4) in which the titer was the same in the two eyes.

This experiment shows that if immunized rabbits are given an injection of horse serum into one anterior chamber and two weeks later receive 2.0 c.c. of horse serum intravenously, horse serum passes into the aqueous in greater concentration in the previously injected eye. These rabbits reacted similarly to those in experiment 2, but the horse serum passed through into the aqueous in a greater number of the rabbits and the concentration was generally greater.

Experiment 5. Although all the eyes of the animals that had received intraocular injections were apparently normal and showed no evidence of inflammation at the time the intravenous injections were given, it was thought advisable to control the experiments with animals that had received similar but nonspecific trauma to the eyes.

Four rabbits received 0.15 c.c. of 25-percent ethyl alcohol into the anterior chamber of the right eye. This injection produced inflammation similar in degree to that resulting from the injection of horse serum into the anterior chamber. After two weeks 2.0 c.c. of horse serum was injected intravenously. The aqueous of each eye was aspirated five hours following this injection and tested for the presence of horse serum. In no instance was any detected.

Another group of four rabbits received similar injections of ethyl alcohol in the right eye and were given intravenous injections of 4.0 c.c. of horse serum two weeks later. This quantity was used because in experiment 1, 4.0 c.c. of horse serum injected intravenously into normal rabbits was the greatest amount that did not regularly pass into the aqueous. When the aqueous was withdrawn five hours after intravenous injection and tested for horse serum, the latter was found in the untreated eye of 1 of the 4 animals. This proportion was the same as that found in the group of four normal rabbits (table 5).

To determine whether the change in threshold was specific for the protein used in immunization, two rabbits were given

TABLE 5

PRECIPITIN TITERS OF HORSE SERUM IN THE AQUEOUS HUMOR OF RABBITS FOLLOWING INTRAVENOUS INJECTION OF HORSE SERUM TWO WEEKS AFTER THE PRODUCTION OF NONSPECIFIC INFLAMMATION OF ONE EYE

Number of Rabbit	Irritating Agent Injected into Anterior Chamber	Quantity of Horse Serum Injected i.v. (c.c.)	Titer of Horse Serum Found in the Eye	
			Treated Eye (Right)	Untreated Eye (Left)
1	Alcohol	2	0	0
2	Alcohol	2	0	0
3	Alcohol	2	0	0
4	Alcohol	2	0	0
5	Alcohol	4	0	0
6	Alcohol	4	0	0
7	Alcohol	4	0	0
8	Alcohol	4	0	1:40
9*	Beef extract	2	0	0
10*	Beef extract	2	0	0

* Sensitized to beef extract.

intravenous and subcutaneous injections of beef extract until antibeef-extract precipitins were demonstrated in titers of 1:4 and 1:8. Each animal gave a positive intradermal reaction to beef extract. Then 0.15 c.c. of beef extract was introduced in the anterior chamber of the right eye. Inflammation resulted similar to that produced by the injection of horse serum in the eye. After two weeks 2.0 c.c. of horse serum was given intravenously, and after five hours the contents of the anterior chambers were aspirated and tested for horse serum. None was found in either eye.

From these observations it appears that the lowering of the threshold for the passage of horse serum from the circulation into the aqueous in experiments 2 and 4 is not due to a nonspecific inflammatory reaction caused by the injections. In the two animals in which beef extract was injected into the anterior chamber of the eye, there was no change in the threshold at which horse serum passed from the blood stream into the anterior chamber two weeks later.

Discussion

In normal adult rabbits weighing 1,800 to 2,800 gm. there is a definite relation between the concentration of horse serum in the circulation and its passage into the aqueous. In only one rabbit that had received less than 5.0 c.c. of horse serum intravenously was there as much as a trace of the serum in the aqueous, and that animal had received 4.0 c.c. intravenously. All rabbits receiving 6.0 c.c. of horse serum intravenously had horse serum in the anterior chamber five hours later.

A previous injection of horse serum into the anterior chamber diminishes the concentration of the serum needed to pass from the blood stream into the aqueous. Not only is the threshold of penetration into the aqueous reduced in the eye that has received the injection, but it is reduced in the contralateral eye although not so greatly. This change in permeability is not dependent on the formation of demonstrable precipitins in the circulation or in the aqueous, as none were found in the animals tested. Nevertheless, it may depend on the formation of precipitins in tissues at the site of injection. Thompson, Gallardo, and Khorazo[5] have found, following immunization by injection of antigen into the anterior chamber of the eye, that precipitins were demonstrable in the cornea, sclera, and sometimes in the uveal tract at a time when none were present in the aqueous.

In these experiments it is evident that intravenous injections of horse serum sufficient to cause the formation of anti-horse-serum precipitins in the blood reduces the threshold for the passage of horse serum between the blood stream and the aqueous. Furthermore, it is shown that in animals in which there had been both ocular and intravenous injections, horse serum passed into the aqueous in a greater proportion of the animals, and the concentration was generally higher (see tables 2, 3, and 4).

Two rabbits sensitized to beef-extract antigen and also injected locally in one eye with this antigen showed no change in the passage of horse serum from the blood stream into the aqueous humor. This experiment suggests that the lowered threshold following immunization is specific for the protein used in immunization.

Inflammation produced in the eyes that were injected had become quiescent by the time the intravenous injections were made. In control animals that had received injections of a nonspecific irritant into the aqueous and were allowed to return to normal, there was no change in the passage of horse serum from the circula-

tion into the anterior chamber. Trauma and associated inflammation are not responsible for the changes in threshold.

Seegal and Seegal[4] thought that the inflammatory reaction produced in an eye by the intravenous injection of the same protein that had been previously injected into this eye was caused by antigen and antibody. From the experiments described in this paper, it is evident that antigen enters the site of preceding injection in greater quantity than it enters normal tissue, and it penetrates the previously injected aqueous with a lower concentration of the antigen in the circulation.

The sympathetic reaction of the contralateral eye is of interest. Its nature is not understood, although associated immunological reactions have occurred in the two eyes. This relation is in accord with the observation that the two eyes are usually involved in the reactions of sympathetic ophthalmia, uveitis, glaucoma, periodic ophthalmia, and cataracts.

Summary and conclusions

1. In normal rabbits, 5.0 c.c. of whole horse serum injected intravenously were necessary to produce sufficient concentration in the circulating blood to cause horse serum to pass into the aqueous within an interval of five hours.

2. In rabbits in which the anterior chamber of an eye had been injected with horse serum, a much smaller quantity (2.0 c.c.) of horse serum injected intravenously produced a concentration in the circulating blood sufficient to cause its penetration into the aqueous.

3. In rabbits immunized with horse serum, a smaller amount of intravenously injected horse serum passed from the blood stream into the aqueous than was the case in normal rabbits.

4. When rabbits, immunized with horse serum and having antihorse-serum precipitins in the blood stream, received an injection of horse serum into the anterior chamber, there was greater penetration into the aqueous following intravenous injection of horse serum than in animals with no immunization otherwise similarly treated.

5. After injection of horse serum into one eye, intravenous administration of horse serum caused penetration of the antigen into the contralateral eye but in less quantity than that which penetrated into the previously injected eye.

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Discussion

Chairman Verhoeff: I should like to ask the essayist if he wouldn't expect a certain, slight allergic reaction in the eye which would be associated with dilatation of the blood vessels, and while this might not account for the blood serum coming in the eye, I should think possibly if in those animals in which he had injected the beef

serum he had injected both beef serum and horse serum and found that only the beef serum got in the eye, that would have excluded the possibility that I am speaking of.

DR. GUY: Anything I could say along that line would be purely speculative. The veins are dilated in the rabbits according to Seegel's phenomenon. They are also dilated in any animal receiving 2 c.c. of whole horse serum, though not so greatly, and associated with that dilatation there is an increase in the body temperature for from two to three weeks.

CHAIRMAN VERHOEFF: Wouldn't that explain why you got the horse serum in the eye in those animals and not in the controls?

DR. GUY: I have no explanation for that.

CHAIRMAN VERHOEFF: In any way you inflame an eye and congest it, the serum will go into the eye most freely, won't it?

DR. GUY: Yes.

CHAIRMAN VERHOEFF: Why wouldn't that account for your result?

DR. GUY: It might.

CHAIRMAN VERHOEFF: Isn't that just the explanation of what you gave?

DR. GUY: I didn't give any.

CHAIRMAN VERHOEFF: I thought you said it was due to precipitants.

DR. GUY: It might be due to antibody-antigen reaction, that causes a reaction at the site of the first injection. There is a definite dilatation following the subsequent injection of the same protein that was injected previously, and this might be a factor.

CHAIRMAN VERHOEFF: Do you think it would be selected so if you had injected both beef serum and horse serum only the beef serum would have appeared the second time ?

DR. GUY: I think it would have, but I didn't do any experiments along these lines, so I shouldn't like to say.

DR. FRIEDENWALD: I should like to ask Dr. Guy whether he did any controls to prove that the horse serum which he found after previous horse-serum injection into the anterior chamber was not the horse serum he put in there.

DR. GUY: I don't quite understand your question.

DR. FRIEDENWALD: You inject some horse serum into the anterior chamber of an animal's eye and then two weeks later you give an intravenous injection of horse serum. How are you sure that the horse serum you find on tapping the aqueous is not a small remnant of what you put in two weeks before?

DR. GUY: Because I have done experiments showing that the horse serum was out of the anterior chamber in 36 hours.

THE CULTIVATION OF CONJUNCTIVITIS- AND KERATITIS-PRODUCING AGENTS ON THE CHORIOALLANTOIC MEMBRANE OF CHICK EMBRYO*

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In 1931 Woodruff and Goodpasture[1] reported that the virus of fowl pox could be grown on the chorioallantoic membrane of the developing chick and that proliferative lesions containing typical inclusions bodies were produced. Other virus workers[2] have since reported that a large number of viruses can multiply and induce lesions in this membrane. Among these are a number which are pathogenic for man; for example, the viruses of vaccinia, smallpox, herpes simplex, psittacosis, epidemic influenza, common cold, measles, yellow fever, Rift Valley fever, Saint Louis encephalitis, and lymphocytic choriomeningitis. Some viruses have failed to develop on the membrane, however, notably those of foot and mouth disease, poliomyelitis, rabies, varicella and virus III.

In addition to its value in providing a relatively simple and inexpensive means of obtaining and maintaining bacteria-free virus, the method has found wide application for the titration of virus and for the demonstration and quantitative estimation of virus-neutralizing antibody. Burnet[3] has stated that in view of the wide range of viruses which have been shown to be capable of growth on the chorioallantois, the method should be included in any investigation of an infective disease of unknown etiology.

In 1933 it was suggested by Goodpasture[4] that the chorioallantois might be "serviceable as a sterile living culture medium for the study of bacterial infection." In 1937 he and Anderson[5] reported a study in which pure cultures of Staph. aureus, Str. haemolyticus, Str. viridans, A. aerogenes, E. typhi, Br. abortus, C. diphtheriae, and Myco. tuberculosis avium were used for inoculation of the membrane. They found that of these all but Staph. aureus, Str. haemolyticus, and C. diphtheriae were able to multiply within the cytoplasm of embryonic cells, either epithelial or mesodermal, but that all of the microörganisms grew well extracellularly in the presence of necrotic material. They concluded that the embryonic tissues of the developing chick offered a relatively simple and uniform medium in which some of the phenomena of invasion and susceptibility might be observed. They found that different host cells varied in their availability for intracellular growth of these parasites and that the experimental lesions in the membranes were characteristic for the bacterial types and in general simulated those found in the natural host. They also concluded that the method could be applied to the study of problems of immunity as well as of susceptibility, since antibody could be introduced into the embryo in significant amounts.

Since then a number of other reports recording the use of the chorioallantois for the study of bacteria have appeared. In 1937 Buddingh and Polk[6] reported on experimental meningococcus infection and Gallavan[7] on H. influenzae infection,

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and in the same year Gallavan and Goodpasture[8] described the production in the embryo of the lesion of whooping cough by H. pertussis. In 1938 Polk, Buddingh, and Goodpasture[9] developed methods by which portals of entry other than the chorioallantois could be ultilized. These methods included intravenous inoculation, infection of the amniotic fluid (utilizing the mouth and nasopharynx as portals of entry), and direct inoculation into the body wall or into the cranial cavity. In the same year Morrow and Berry[10] described the cultivation of N. gonorrhoeae on the membrane and the use of the technique for the study of sulfanilamide action. They found that a solution of the drug dropped on the membrane 24 hours before inoculation protected against infection, and that after a gonococcal infection had been established for 24 hours the amount of sulfanilamide required to eradicate the organism was twice the prophylactic dose. In 1939 Buddingh and Polk[11] reported additional studies on meningococcic infection of the chick embryo including one on passive immunity. In 1940 Anderson and Snow[12] reported the isolation and cultivation of H. ducreyi on the chorioallantois.

The membrane has also been applied to a study of Rickettsiae by Bengtson and Dyer[13] who cultivated the agent of Rocky Mountain spotted fever on it. More recently Cox[14] found that the yolk sac was even more useful than the chorioallantois in the cultivation of Rickettsiae.

Experimental studies

In view of the wide application of the egg-membrane technique to the problems of infection, a survey of its possible uses in the study of infectious agents causing conjunctivitis and keratitis was undertaken. From a review of the literature it seemed possible that the method might yield valuable information in the following problems: (1) The isolation and identification of known ocular viruses; (2) the isolation of viruses, bacteria, or other agents from conjunctivitis and keratitis of unknown etiology; and (3) the differentiation of pathogenic from nonpathogenic strains of bacteria. Accordingly a large series of cases of conjunctivitis and keratitis of known and unknown etiology have been studied on the chorioallantois.

Material and methods

Cases of conjunctivitis and keratitis at the Vanderbilt Clinic and the Institute of Ophthalmology were available for study. Material consisting of secretion or conjunctival and corneal scrapings was suspended in small amounts of Tyrode solution. Fertile eggs, incubated for from 10 to 12 days and in which the chorioallantoic membrane was exposed through a window cut in the shell according to the technique described by Burnet[2] were inoculated with tissue-culture pipette drops of the material under study. In addition to the series of direct transfers of material from conjunctivitis and keratitis, a second series of inoculations was made with cultures of known conjunctival and corneal bacteria, both pathogens and saprophytes.

According to the technique outlined by Burnet,[2] the egg (previously incubated at 100-103°F. for 12 days) is first examined by transillumination in a viewing box, the limits of the air sac are marked, and a suitable region over the chorioallantois is chosen and marked for inoculation. With a dental drill fitted with a vulcanite-carborundum cutting disc, a small hole is made into the air sac. An opening in the form of an equilateral triangle with sides about 1.2 cm. in length is then cut over the area, and the triangle of shell removed with a forceps and set aside for replacement. A slit is now made in the exposed shell membrane with a needle

that is held nearly horizontally to avoid injuring the underlying delicate chorioallantois. Suction over the opening in the air sac is then applied; this results in the displacement of the egg contents into the air sac and allows a new artificial air space to form between the chorioallantois and the shell membrane. The chorioallantois is then inoculated through the enlarged shell-membrane opening with the pipette held vertically, care being taken not to let any of the fluid touch the shell membrane. The egg is then sealed in any convenient fashion; in the present experiments the triangle of shell was replaced and sealed with melted paraffin which was also used to seal the small opening into the natural air space.

The inoculated eggs are incubated for from two to seven days at temperatures ranging from 35°C. to 37°C. since, according to Burnet, best growth of viruses and probably of other agents is obtained at temperatures below the normal incubation temperature for the hen egg. At the end of the incubation period the shell over the artificial air sac is removed and the shell membrane is cut away with scissors, exposing the chorioallantois.

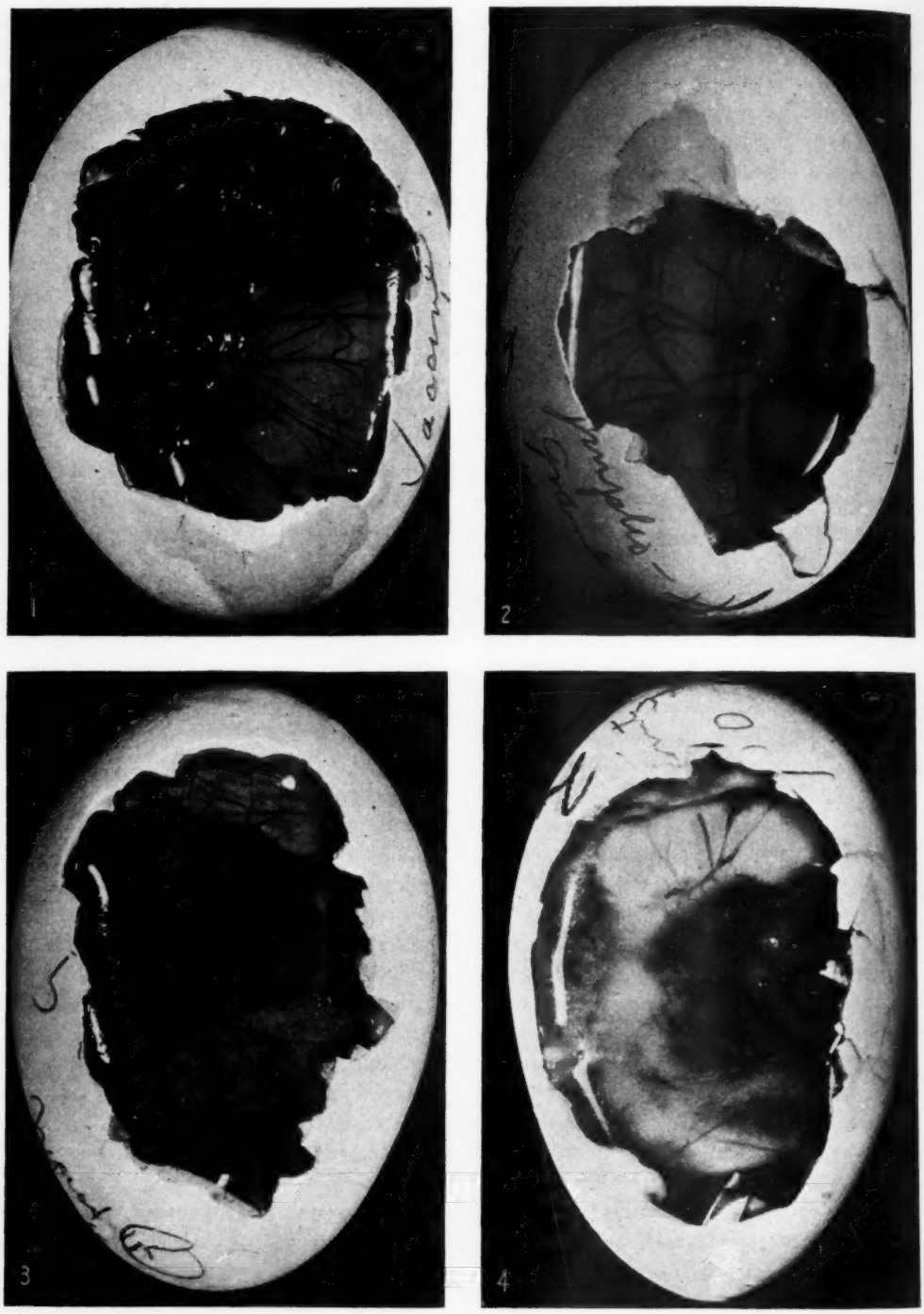
NONSPECIFIC LESIONS OF THE CHORIOALLANTOIS

It is natural that such a delicate membrane as the chorioallantois should show certain nonspecific lesions as a result of the damage done by simple exposure and by the fluid used to suspend the material to be tested. Membranes exposed in the usual manner and inoculated with sterile Tyrode solution or broth have shown slight diffuse thickening and a few fine granular opacities. More rarely large opaque gray areas with streaks of opacity extending outward along the vessels, described as traumatic ulcers by Burnet,[2] have appeared.

These nonspecific lesions, which seem to be more prominent when noninfective suspensions of conjunctival secretion or scrapings are used, have been the source of considerable confusion in the study of material from suspected virus diseases. With material from acute follicular conjunctivitis (Béal), for example, lesions of this type were obtained and apparently transmitted in series. Since it was impossible to obtain infection by various routes in any of the ordinary laboratory animals, including monkeys and baboons, with this membrane material, it had to be concluded that the lesions were probably nonspecific in character. With bacteria or readily identifiable viruses—such as vaccinia virus—these nonspecific lesions are of no importance, but it is clear that their occurrence limits the value of the membrane technique for the isolation and identification of as yet unidentified viruses.

A STUDY OF CONJUNCTIVITIS AND KERATITIS OF KNOWN VIRUS ETIOLOGY

Vaccinia. Material from a single case of accidental vaccinial infection of the eyelids and conjunctiva was available for study. On the rabbit cornea the material removed from the vesicles produced a typical vaccinial keratitis in which elementary bodies and cytoplasmic inclusions (Guarnieri bodies) were demonstrated. On the chorioallantois, however, the material produced a dense diffuse necrotic lesion from which Staphylococcus aureus was grown in culture and demonstrated in smear. The demonstration of elementary bodies in Victoria-blue-stained smears indicated that vaccinia virus had developed simultaneously with the staphylococcus on the membrane but in view of the known resistance of the rabbit cornea to bacterial infection, corneal inoculation would still seem to be the method of choice in



Figs. 1-4 (Thygeson). See description next page.

the direct isolation and identification of vaccinia virus.

A large number of transfers of vaccinia virus (New York City Board of Health strain) to the chorioallantoic membrane were made. There was no difficulty in obtaining the typical focal proliferative lesion (fig. 1) which has been described for this virus or of maintaining the virus by serial transfer. Nor was there any difficulty in demonstrating the vaccinia elementary bodies in smears from the membrane stained by the Morosow or Victoria-blue method, nor in demonstrating Guarnieri bodies in Giemsa-stained preparations.

Herpes simplex. Six cases of herpes corneae were studied on the chorioallantois. Corneal curettings from four produced discrete proliferative lesions which were smaller and less active than the lesions of vaccinia virus, some being only with difficulty distinguishable from nonspecific lesions. There was also greater difficulty than with vaccinia virus in maintaining the virus by serial transfer.

Thus, as in the case of vaccinia virus, inoculation of rabbit cornea appeared to be a more sensitive test for the presence of herpes virus than inoculation of the chorioallantois.

Herpes zoster. Vesicle fluid from a single case of herpes zoster ophthalmicus showing active corneal disease was obtained for the inoculation of the chorioallantoic membrane. No membrane lesions were obtained in eggs incubated at 37°C. and at 35°C.

Trachoma. Material from 45 trachoma cases in whites and Indians, selected because of high activity, was used for the inoculation of the chorioallantoic membrane without obtaining in any instance either specific membrane lesions or survival or multiplication of the virus, as evidenced by inoculation of baboons with membrane material. In view of the long incubation period of trachoma (five days minimum), some of the inoculated eggs were allowed to progress to hatching. Normal chicks resulted.

As was to be expected in view of the frequency of secondary bacteria in trachoma, a number of eggs developed infection with various bacteria, including Staph. aureus, D. pneumoniae, H. influenzae, K. pneumoniae, and H. duplex (Diplobacillus of Morax-Axenfeld). It is noteworthy that the egg membrane appeared to be much more sensitive to the diplobacillus, especially to the nonliquefaciens and Petit types, than to the other bacteria, profuse growths being obtained from material which had not shown the organism on blood-agar cultures. This sensitivity of the chorioallantois to the diplobacillus will be taken up in detail later.

Inclusion blennorrhea. Eleven cases of inclusion blennorrhea have been studied by the egg-membrane technique. In no instance were specific lesions of the chorioallantois obtained. In five experiments the inoculated membranes were tested for survival of virus by inoculation of the eyes of baboons; the results were negative.

Lymphogranuloma venereum. Recent reports[15] indicate that the virus of lymphogranuloma venereum is one of the causes

Fig. 1 (Thygeson). Mild vaccine virus lesions of chorioallantois. Forty-eight hours incubation at 37°C.

Fig. 2 (Thygeson). Mild localized proliferative lesions of chorioallantois four days after inoculation with virus of lymphogranuloma venereum.

Fig. 3 (Thygeson). Lesion of chorioallantois produced by inoculation with material from a case of diplobacillary conjunctivitis. Forty-eight hours incubation at 37°C.

Fig. 4 (Thygeson). Fulminating necrotic lesion of the chorioallantois produced by inoculation with the diplobacillus of Petit. Forty-eight hours incubation at 37°C.

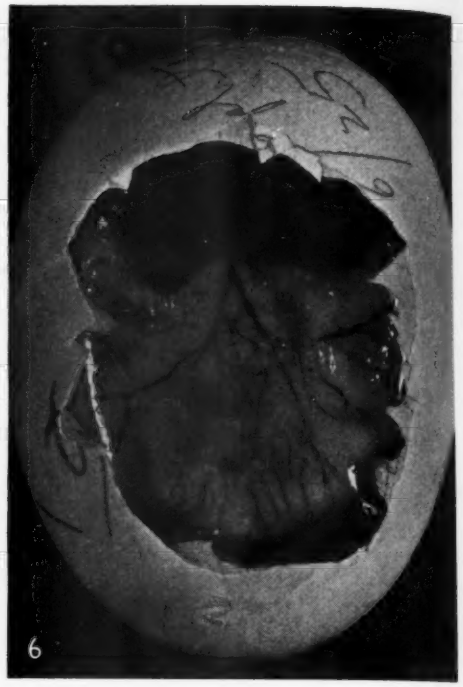


Fig. 5 (Thygeson). Severe ulcerative diffuse lesion of chorioallantois produced by secretion from a case of pneumococcic conjunctivitis. Forty-eight hours incubation at 37°C.

Fig. 6 (Thygeson). Diffuse necrotic lesion of chorioallantois produced by inoculation with pure culture of C. diphtheriae. Forty-eight hours incubation at 37°C.

of the oculoglandular syndrome of Parinaud, and a primary ocular infection with the virus, observed at the Vanderbilt Clinic, has been reported by Curth, Curth, and Sanders.[16] Healing took place under prontosil therapy.

Although Miyagawa[17] and associates have reported the cultivation of this virus on the chorioallantois and its serial passage, a strain furnished by Dr. M. Sanders showed very little activity on the membrane, initial lesions (fig. 2) being obtained only with difficulty. In a number of attempts it was not possible to carry the strain beyond the third serial passage; further passages showed no membrane lesions and mouse-brain inoculations proved negative.

Molluscum contagiosum. Two cases of molluscum contagiosum of the lid margins with associated conjunctivitis were available for study; one showed a severe keratoconjunctivitis simulating trachoma. Material from these cases, consisting of both conjunctival scrapings and expressed material from the lid-margin nodules, was used for the inoculation of the chorioallantois without success.

A STUDY OF CONJUNCTIVITIS AND KERATITIS OF SUSPECTED VIRUS ETIOLOGY

Acute follicular conjunctivitis (Béal). Scrapings from three cases of acute follicular conjunctivitis (Béal) were tested on the chorioallantois. Some of the inoculated membranes showed minor focal lesions of questionable nature which could apparently be transmitted in series but which failed to induce infection of any sort in mice, rats, rabbits, monkeys (M. rhesus), or baboons.

Superficial punctate keratitis. Three at-

tempts to infect the chorioallantois with material from cases showing typical superficial keratitis were unsuccessful. It should be noted, however, that it was possible to obtain corneal scrapings from only one of these cases, conjunctival scrapings being used in the other two.

Ocular pemphigus. Material from six cases of ocular pemphigus was tested on the chorioallantois, but no lesions suggestive of virus infection developed. As was to be expected, many of the eggs showed bacterial infection, but in no instance was any bacterial species found which could not be found in culture or which could be considered as having etiologic significance.

Chronic follicular conjunctivitis. Material obtained from the two cases of chronic follicular conjunctivitis that were available for study showed no bacteria of significance and no inclusion bodies on examination of smears and scrapings or on ordinary culture media. They appeared to correspond to the entity of unknown etiology described by Morax[18] for which an infectious nature seems to have been established by the transmission experiments of Axenfeld[19] and Taborisky.[20] Epithelial scrapings from these two cases failed to produce specific viruslike lesions on the chorioallantois or to yield significant bacterial growths.

Erythema multiforme. A single case of erythema multiforme, bullous type, with severe purulent ophthalmia, was available for study. Smears and epithelial scrapings from the conjunctivae showed enormous numbers of pus cells but no significant bacteria, while cultures revealed only a few colonies of C. xerosis and Staph. albus. Smears and cultures from the skin lesions likewise failed to reveal significant bacteria but Victoria-blue- and Giemsa-stained smears of bulla fluid showed clumps of minute round granules having the appearance of elementary virus bodies.

Bulla fluid was used for inoculation of rabbits, mice, guinea pigs, and baboons by various routes without inducing demonstrable changes of any kind. The same materials on the chorioallantois, however, caused death of the embryo with proliferative membrane lesions which yielded bacteria-free smears and cultures. Smears from the membrane showed the same elementary-bodylike granules though in smaller numbers than in the bulla fluid. An attempt was made to transfer the lesions in series, but there was failure after the second transfer. The second transfer, however, showed the same elementary-bodylike granules in smears from the membrane. Ground membrane and embryos from the first and second transfers failed to induce lesions when injected intracerebrally and intraperitoneally in mice.

A STUDY OF BACTERIAL DISEASES OF THE CONJUNCTIVA AND CORNEA

Staphylococcic conjunctivitis. Twenty-five cases of typical staphylococcic conjunctivitis from which hemolytic Staph. aureus was obtained on culture were studied by the egg-membrane technique. Infection of the membrane was obtained in every case. The lesions produced were rapidly progressive and diffuse and resulted in the death of the embryo in most cases by the second or third day. Smears from the membrane were always loaded with staphylococci.

Diplobacillary conjunctivitis. This type of conjunctivitis appears to be uncommon in New York City and only five cases of the disease were available for study from Vanderbilt Clinic. Fortunately, a minor epidemic of chronic conjunctivitis at a mental institution near Near York City provided a considerable number of pure infections as well as cases of mixed infections in which the diploba-

cilli were associated with Staph. aureus, D. pneumoniae, or H. influenzae. The diplobacilli, while presenting a uniform morphology in smear preparations, were found on culture to fall into three types corresponding to the typical Morax-Axenfeld, the nonliquefaciens, and the Petit types.

The chorioallantois exhibited a high degree of sensitivity for material containing diplobacilli (figs. 3 and 4) of all three types, but the membrane lesion produced by the nonliquefaciens and Petit types was particularly fulminating, resulting in rapid death of the embryo and necrosis of the membrane. This high degree of sensitivity of the chorioallantois to diplobacilli was well shown during a study of trachomatous materials obtained from Apache Indian children and adults when diplobacilli were obtained on the egg from seven cases which had failed to show the organisms by ordinary culture methods. It would appear that the chorioallantois is a better culture medium than rabbit-blood agar or Loeffler's coagulated-blood serum for these organisms, and it is possible that the egg may prove of value in the study of mild cases of the disease in which the organisms are too few in number to be easily recognized in smear or to be recovered by ordinary culture methods.

Gonorrheal conjunctivitis. A single series of chorioallantois inoculations made from a case of gonorrheal ophthalmia failed to produce infection of the membrane.

Influenza bacillus conjunctivitis. Material from two cases of influenza-bacillus infection studied on the membrane produced infection, although there appeared to be a higher degree of resistance to this organism than to Staph. aureus or to the diplobacillus and the diffuse lesion formed more slowly. Smears from the infected membranes showed relatively small numbers of the organism.

Pneumococcic conjunctivitis. Secretion from three cases of acute pneumococcic conjunctivitis produced infection of the chorioallantois (fig. 5). It was of moderate severity as compared with that produced by the staphylococcic and diplobacillary cases but numerous pneumococci could be demonstrated in smears from the membranes.

Proteus conjunctivitis. Two cases of severe chronic conjunctivitis from which organisms of the proteus group were obtained were available for study. In each instance a fulminating infection of the chorioallantois developed, smears from which were loaded with organisms.

Conjunctivitis associated with gram-positive filamentous organisms of Erysipelothrix group. A single case of unilateral chronic conjunctivitis, which showed in smears and culture large numbers of gram-positive filamentous organisms of the Erysipelothrix group, was studied on the chorioallantois without result. The organism from culture, however, proved capable of infecting the membrane. It is of interest that the organism which showed a predominance of small clumped granular forms in smears from the conjunctiva also showed these forms on the chorioallantois, which in culture the organism was almost entirely filamentous.

Lacrimal conjunctivitis. A single severe case of lacrimal conjunctivitis secondary to beta-hemolytic streptococcus infection of the lacrimal sac was studied on the chorioallantois. A satisfactory infection of moderate severity was obtained and numerous streptococci were found in smears from the membrane.

Conjunctivitis of mixed origin. There were four cases of chronic conjunctivitis in which both diplobacilli and Staph. aureus could be demonstrated on smear and culture examination. Transfer of material from these cases to the chorioal-

lantois resulted in immediate and severe infection, smears from which were loaded with both staphylococci and diplobacilli. In the same way material from three cases of chronic conjunctivitis showing Staph. aureus and H. influenzae also produced infection of the chorioallantois; in smears the staphylococci were more numerous than the influenza bacilli. There were also three cases of chronic conjunctivitis with mixed diplobacillus and influenza-bacillus infection. Material from both produced infection of the chorioallantois, the diplobacillus predominating in smears from the membranes. Other mixed infections, including (1) D. pneumoniae and Staph. aureus, (2) H. influenzae, Staph. aureus, and diplobacilli, and (3) Staph. aureus and H. influenzae, likewise developed on the chorioallantois.

Fusospirochetal conjunctivitis. Five series of inoculations of the chorioallantois from two cases of Vincent's infection of the conjunctiva, in which spirochetes, fusiform bacilli, and anaerobic streptococci were demonstrated by ordinary methods, failed to induce lesions of the chorioallantois. It was possible, however, to infect the membrane with pus from experimental fusospirochetal lesions in the guinea pig. A heavy inoculum (0.2 c.c.) produced a fulminating necrotic lesion, but a single capillary drop produced only a mild lesion on 48 hours of incubation. Organisms were numerous in the first lesion, scanty in the second.

Streptococcic ulcer. A single case of severe hypopyon ulcer from which beta-hemolytic streptococci were the only organisms isolated was studied on the chorioallantois. A spreading lesion of the membrane was induced from which typical streptococci were recovered in smears and culture.

Parinaud's conjunctivitis. Two series of inoculations to the chorioallantois from each of three cases of Parinaud's oculoglandular syndrome were made with minced biopsy material from active lesions. In one of the cases numerous leptotriches were found in section, but in the other two no organisms were found. Possibilities such as tuberculosis, syphilis, lymphogranuloma venereum, and tularemia were excluded. None of this material produced specific lesions on the chorioallantois.

A STUDY OF KERATITIS AND CONJUNCTIVITIS OF UNDETERMINED ETIOLOGY

Mooren's ulcer. Scrapings taken directly from the lesions in two cases of Mooren's ulcer failed to produce lesions on the chorioallantois. No significant bacteria were found in the material from either case by ordinary bacteriologic methods.

Severe nonspecific conjunctivitis. During the course of this study, six cases of severe chronic conjunctivitis having no characteristic features were observed in which examination by ordinary culture methods yielded negative results. In each case the severity of the inflammatory signs and the relative abundance of the purulent or mucopurulent discharge left but little doubt of the infectious nature of the disease. Egg-membrane inoculations from these cases, however, failed to result in viruslike lesions or to yield bacteria not also found in culture by ordinary bacteriologic methods. In two of the cases mild diffuse opacities in the membrane were seen but these could not be transmitted in series and were probably nonspecific.

There were three cases of severe keratoconjunctivitis of particular interest because of their unusually severe onset and course and because of the failure of all smear and culture techniques to yield etiological information. In spite of the obviously infectious nature of the cases, repeated attempts to affect the chorioal-

lantois with secretion and epithelial scrapings failed.

A single case of persistent subacute conjunctivitis, in which numerous large, regular, gram-positive rods, morphologically identical with Döderlein's bacilli, were consistently present in smears, was inoculated repeatedly on the chorioallantois. The organism failed to multiply. Attempts to grow it on ordinary culture media also failed, but it was finally isolated on special media and identified as a member of the lactobacillus group.

A STUDY OF CHRONIC CATARRHAL CONJUNCTIVITIS

As is well known, a considerable proportion of cases of chronic catarrhal conjunctivitis show only a normal bacterial flora. It seemed reasonable to expect that some of these might be caused by a virus or viruses which would produce specific proliferative lesions on the chorioallantois and accordingly a large number of inoculations were made with secretion or epithelial scrapings from representative cases. In no instance did specific lesions of the chorioallantois result. It is of interest, moreover, that from one of these cases herpes simplex virus was demonstrated by corneal inoculation when the same material failed to affect the chorioallantois, although the membrane supported the virus when transfer was made from the cornea to the egg. This demonstration of herpes virus is of special importance since the patient showed no corneal lesions of any kind and had no history of dendritic keratitis and no suggestive residual corneal scars.

TABLE 1

INOCULATION OF PURE CULTURES OF CONJUNCTIVAL BACTERIA ON CHORIOALLANTOIC MEMBRANE

	Growth	No growth
N. gonorrhoeae	0	4
N. catarrhalis	5	1
H. influenzae	4	8
Diplobacillus (Morax-Axenfeld)	4	1
Diplobacillus of Petit	4	0
Diplobacillus nonliquefaciens	5	0
D. pneumoniae	2	0
Streptococcus (beta hemolytic)	1	0
Streptococcus viridans	2	0
Streptococcus (non-hemolytic)	5	0
Staphylococcus aureus		
(mannitol and coagulase positive)	6	0
(mannitol negative and coagulase positive)	2	0
(mannitol and coagulase negative)	2	0
Staphylococcus albus (mannitol negative)	6	0
C. diphtheriae	2	0
C. xerosis	2	0
C. pseudodiphthericum	2	4
E. coli	1	0
Ps. aeruginosa (pyocyaneus)	3	0
Proteus		
typical	2	0
atypical	2	0
Klebsiella pneumoniae	3	0
Erysipelothrix (from chronic conjunctivitis)	1	0
Actinomyces (streptothrix from lacrimal concretion)	0	2
Fusiform bacilli (Vincent's angina)	1	0
Sarcina	4	3

THE REACTION OF THE CHORIOALLANTOIS TO INOCULATION WITH BACTERIA OF THE CONJUNCTIVAL FLORA

Table 1 summarizes the results obtained from the inoculation of the chorioallantois with cultures of the conjunctival bacteria. It will be seen that the membrane is capable of supporting the growth of all the pathogenic bacteria found in the normal and in the inflamed conjunctiva. As was to be anticipated from the direct transmission of infected materials, there was a considerable difference in the intensity of the reaction produced on the membrane (fig. 6). Here again diplobacilli of the Petit and nonliquefaciens types and staphylococci produced the most fulminating infections while H. influenzae produced probably the least reaction of all the pathogenic bacteria.

It is of interest to note that the chorioallantois was relatively resistant to the conjunctival saprophytes such as C.

xerosis and other diphtheroids. Only with large inoculations could low-grade membrane lesions be produced. The membrane was less resistant to supposedly nonpathogenic white staphylococci (mannitol negative, coagulase negative) which produced ulcerative lesions of low intensity when inoculated from culture. On the other hand, the membrane was able to eliminate white staphylococci present in small numbers in tears from normal cases.

Discussion

While the chorioallantois would seem to be capable of supporting the growth of the majority of the bacterial agents of keratitis and conjunctivitis, it did not grow any bacteria not found on ordinary bacteriological media and, except in the cultivation of the diplobacillus, proved inferior to standard methods of isolation and identification. In the case of diplobacilli, organisms often difficult to isolate on ordinary bacteriological media, membrane inoculations from suspected diplobacillary conjunctivitis would appear to have definite value, at least until more selective bacteriological media for the organism can be developed.

It remains to be seen whether or not the chorioallantois will be of value in differentiating pathogenic from nonpathogenic bacteria. Certainly there was sharp differentiation in these experiments between the two types of staphylococci and corynebacteria. Also still to be explored is the value of the chorioallantois in the study of epithelial parasitism.

In view of the wide susceptibility of the chorioallantois to viruses in general, the failure of the membrane to grow ocular viruses other than those of vaccinia and herpes simplex must be considered extremely disappointing. Also disappointing was the failure of material from suspected virus diseases—such as acute follicular conjunctivitis, Béal, chronic follicular conjunctivitis, and ocular pemphigus—to produce specific lesions on the chorioallantois. Not unexpected, however, was its failure to develop lesions after inoculation with material from severe keratoconjunctivitis of unknown etiology and from bacteria-negative chronic catarrhal conjunctivitis.

Conclusions

1. All the important bacterial agents of keratitis and conjunctivitis grew well on the chorioallantoic membrane of the developing chick embryo when transferred from culture, and the majority grew well when transferred directly in exudate or epithelial scrapings. Exceptions to the latter were the agents of fusospirochetal disease and gonorrheal ophthalmia.

2. The chorioallantois appeared to have a special susceptibility to the diplobacillus, especially to the Petit and nonliquefaciens varieties, inoculations with these organisms resulting in fulminating infections. Only small numbers of the diplobacilli were required to produce infection, and in a number of instances the organism grew on the chorioallantois when ordinary bacteriological methods had failed.

3. The virus of vaccinia produced severe proliferative lesions on the membrane, and the viruses of herpes simplex (herpes corneae) and lymphogranuloma venereum produced smaller lesions, but the viruses of herpes zoster, trachoma, and inclusion blennorrhea produced no effect at all.

4. Material from conjunctivitis and keratitis of unknown etiology, including ocular pemphigus, acute follicular conjunctivitis (Béal), chronic follicular conjunctivitis, Mooren's ulcer, and bacteria-negative nonspecific severe keratoconjunctivitis, failed to produce specific lesions of the chorioallantois. A possible

exception to this was a case of erythema multiforme, bullous type, with severe purulent ophthalmia and stomatitis, in which transfer of bulla fluid to the chorioallantois resulted in (1) death of the embryo, and (2) membrane lesions in which granules having the appearance of elementary virus bodies were demonstrated. These bodies were also found in the bulla fluid itself. The membrane lesions could not be transmitted in series, no changes being produced after the third passage.

5. The conjunctival saprophytes, including C. xerosis and other diphtheroids and nontoxic white staphylococci, when transferred directly in exudate or scrapings and unaccompanied by pathogenic bacteria, failed to grow on the membrane. When accompanied by pathogenic bacteria the saprophytes occasionally multiplied in the necrotic surface material resulting from the infection.

6. Egg-membrane cultures would appear to be of particular value in the study of suspected herpes or vaccinia and of suspected diplobacillary infection when ordinary culture methods have failed. They may also be found to be useful (1) in immunological studies of viruses and bacteria; (2) in the study of the phenomena of epithelial parasitism; and (3) in the maintenance of viruses and bacteria in a virulent condition. These possible uses will be considered in a subsequent report.

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GLASS MEMBRANES IN THE EYE*

Part I. Bowman's membrane, descemet's membrane, and lens capsule

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Bowman's membrane and descemet's membrane

In a case of Groenouw's nodular corneal dystrophy Ernst Fuchs described anatomically two different kinds of corneal incrustations best differentiated with Giemsa staining. A uniform layer on the *anterior* part of Bowman's membrane, closely connected with this membrane, which is often split, stained *red* with Giemsa, bluish-gray with Weigert, sending pseudopodialike processes between the basal cells of the epithelium. Among my slides—I have observed three cases histologically—this substance is without structure, hyaline in nature, *pinkish* stained, and *acidophil*. Posterior to Bowman's membrane in the opened lamellae of the cornea there are corpuscles of various dimensions: the smallest hardly visible under the highest power; the largest the size of an epithelial cell. Transitions from the smallest corpuscle to the largest are visible in a single field in the microscope. They are stained with Giemsa, *blue* and *basophil*.

Here I hasten to add that in slides of a case published by Buchanan and Michaelson, which I was able to study and stain again, I could see that the sharp distinction between the two substances was perceptible only in those places *where Bowman's membrane was preserved*. It was missed in places where Bowman's membrane was destroyed over larger areas. Here the incrustations were not characteristic, but formed an amorphous, granular mass stained gray with Giemsa.

The fact that Bowman's membrane *separated two differently reacting tissues* is as biologically interesting as it is surprising.

The functions of the glass membranes in the eye have interested me for a long time, leading me to collect anatomical material to elucidate at least some of the important points. We will confine our attention to the membranes of Bowman and Descemet, to the lens capsule, and to the lamina vitrea chorioideae. The glass membranes of the vessels do not concern us here, although they have great biological and pathological importance.

There is no doubt that the glass membranes add to the firmness of the whole structure of this delicate organ. Descemet's membrane, especially, with its elastic tissue, is a first-rate frame. We may assume a similar mechanical importance for the lamina vitrea chorioideae, much needed to counterbalance the variations in intraocular pressure, varying with every pulsation. We know very well how great are the alterations of the lens capsule, which is intimately involved in all the changes in the shape of the lens.

What I want to stress is that besides this very important scaffolding function of the glass membranes there is another equally important one—that of *controlling the metabolism* of the tissues connected with them. Living tissues are dependent on a certain kind of nourishment. When it differs greatly from its normal quality, they show abnormal reactions, with a pathological change in their biological functions. The tissues of the body, muscles, connective tissues, glands, and so forth, allow a relatively wide variation

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in the quality of their nourishment without any notable disturbance of their function. But the tissues of the eye that are provided with glass membranes—cornea, lens, and retina—are *transparent. The exact preservation of the transparency of these tissues demands a far greater constancy in the permeating fluids,* not only in their composition, but in osmotic pressure and pH value also. Bowman's membrane, for example, forms a barrier uninterrupted except for the perforations for the delicate nerve fibers which protect the sensitive transparent parenchyma of the cornea against possible injurious substances.

There is no part of the living tissues where the local *physiological fluids* (excluding the excretions) are *dangerous for the functions;* but the fluid of the anterior chamber is capable of making the cornea as well as the lens opaque. While the corneal opacities so formed disappear in a very short time when further entrance of the fluid is stopped, traumatic lens opacities very often progress. The turbid lens fibers may even be reabsorbed through the action of the ferments contained in this liquid. Having regard to these well-known facts, we understand that the function of the glass membranes with their epithelium and endothelium, respectively, cannot be *mechanical* only, but that they have to fulfill another very important task, the *exact control* of the fluids for the metabolism, and especially to maintain the *transparency,* of the tissue which forms the refracting media.

The living cornea is a *semipermeable* membrane. As long as the epithelium and the endothelium remain intact, a certain selectiveness in permeability is retained (Duke-Elder). Potassium passes inward to the anterior chamber—not outward. The entrance and the diffusion of certain substances from the conjunctival sac into the eye is possible and dependent on the chemical and physical constitution of the fluid. F. P. Fischer showed that potassium iodide when instilled into the rabbit's eye is traceable in one-and-a-half minutes in the cornea and in two minutes in the fluid of the anterior chamber. The permeability of the corneal tissue *changes with the actual reaction* of the fluid used. No attempt has been made so far to discover what part of this tissue reacts differently to the variation of the pH. Later authors stress the role of the glass membranes.

The first interesting subject for study is the boundary between the *corneal epithelium* and the *anterior part of Bowman's membrane.* I have looked over a large number of microscopic slides, and have found that in the central part of the cornea, important from the optical point of view, this boundary, in normal eyes, is always sharp. The basal cells fit together to form a well-defined base line—indefinite in the peripheral limbal part. The nuclei of the basal cells are situated in a row—not too near Bowman's membrane—so that the plasma at the base of the foot-cells forms a distinct band. Studying this plasma between the nuclei of the foot-cells and Bowman's membrane, it is seen to contain many drops of different size (fig. 1), all situated at the border line adjacent to Bowman's membrane. The drops are to be seen *only* in the basal part of the foot-cells. They are not stained at all, not even with supravital staining (neutral red, methylene blue, litmus, Giemsa, and so forth). I found that they were much larger and more numerous in cases of high intraocular pressure. There the sharp border line between the foot-cells and Bowman's membrane is very often blurred (fig. 2). Only once did I observe in a case of secondary glaucoma tiny hematoxylin-stained dark-blue corpuscles mixed with unstained droplets.

To avoid too high degrees of denaturalization by fixation, I tried to stain *supravitally,* one hour after enucleation, the cornea of an eye suffering from secondary glaucoma, believing that the chemical reactions between tissue and stain correspond more to the physiological conditions. The cornea was divided into three pieces and cut with the freezing microtome. The slides were stained (without fixing, of course) with Giemsa, litmus, methylene blue, phenolphthalein, and neutral red. The *nuclei* of the epithelium are stained with Giemsa very sharply blue-violet, the plasma of the epithelial cells pale blue, the form of the epithelial

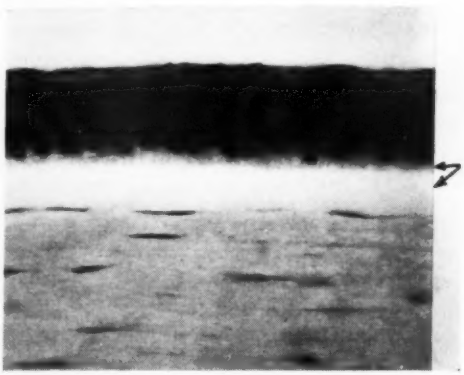

Fig. 1 (Loewenstein). Showing (upper arrow) tiny droplets of the plasma of the foot-cells. Note the sharp delimitation between the epithelium and Bowman's membrane (lower arrow).

cells being retained exactly, better than with fixed slides. *Bowman's membrane* is pinkish, nearer to red than the lightly stained pinkish lamellae. *It is to be stressed that even in unfixed tissue the epithelium is stained with basic stains, while Bowman's membrane and the lamellae are acidophil—reddish.* I was not successful in obtaining a reaction with litmus (watery, concentrated). There was very slight bluish staining of the nuclei in the epithelial cells, with beautiful cell borders, but no staining of the lamellae

Fig. 2 (Loewenstein). The delimitation between Bowman's membrane and the epithelium is not sharp. Many droplets are seen in the plasma of the foot-cells.

or Bowman's membrane. No difference in reaction could be recognized microscopically in the tissue in front of and behind Bowman's membrane. With polychrome *methylene blue* the nuclei of the epithelial cells were steel blue, as well as the nuclei in the corneal lamellae. Bowman's membrane and the lamellae were not stained. There are very distinct granules in the plasma of the epithelial cells whose nuclei are quite different from those seen in fixed (hardened) preparations. They are all spherical, with no sign of plasmolysis. I do not know the significance of the aforementioned bright-blue corpuscles in the foot-cells.

There is no staining at all with *phenolphthalein,* but a trace of yellowish discoloration of the epithelium, while Bowman's membrane is a clear shining band. With *neutral red,* the nuclei of the epithelial cells are carmine red, the epithelial-cell plasma light pinkish, Bowman's membrane amber-yellow and more brilliant than Descemet's membrane, the nuclei in the parenchyma carmine red.

The staining of the epithelial cells is always different from that of Bowman's membrane and the parenchymatous layers. Especially with Giemsa do we realize

in supravital staining the basophil reaction of the azure-stained epithelium and the acidophil reaction of the eosin-tinted Bowman's membrane. Bowman's membrane is redder than the corneal lamellae. The difference in reaction does not seem great enough to obtain a difference in staining with litmus, as I had hoped. I did

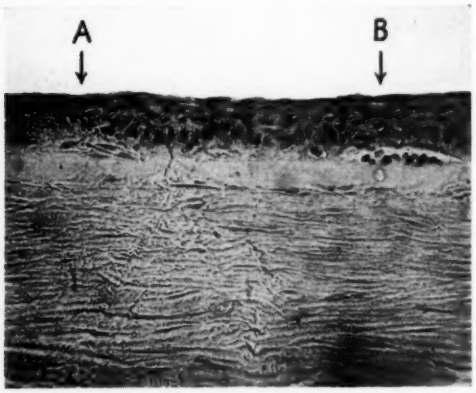

Fig. 3 (Loewenstein). Pannus degenerativus. First appearance in an eye with glaucoma absolutum. A, newly formed subepithelial vessels; B, subepithelial vacuoles with cellular nuclei.

not succeed in finding a better technique to prove the difference in the actual reaction of these two tissues. No tissue of the cornea is alkaline enough to give a phenolphthalein reaction, which occurred immediately when I added lithium carbonate to the slide. As far as we may conclude from our common experience of stained, hardened slides and the supravitally stained slides, the epithelial layer reacts differently from Bowman's membrane—the former with basic stains and the latter with acid ones.

I assume that the fluid coming from the conjunctival sac and from the limbal vessel system flows from the surface of the epithelium to Bowman's membrane and seems to find an obstacle there, as we realize from the accumulation of droplets at the foot of the basal cells. When the intraocular pressure is increased, this obstacle seems to be greater. We find the drops larger and the border line between the basal cells and Bowman's membrane obliterated (fig. 2). The same is not infrequently to be observed at some places in the normal eyes of very old people. In the case of an old glaucoma, I have found unstained vacuoles, within Bowman's membrane, situated near its anterior and posterior surfaces, and sharply defined—perhaps a sign of degeneration within this membrane.

In the case of glaucoma, this fluid stream is retained, and the droplets are collected between the epithelial layer and Bowman's membrane. At first there develops the small fissure that is well known from the histology of glaucoma (Elschnig) leading to the irregularities of the corneal surface. These fissures, which remain for a long time, become a real detachment of the epithelial layer (fig. 3), with large vesicles, clinically often described in cases of long-standing increased intraocular pressure. Anatomically these vesicles (Elschnig) contain a small amount of débris; the older the detachment the thicker the débris. With the narrow beam of the slitlamp, we may observe this unevenness, in cases of corneal inflammation, not only over the site of the corneal infiltration but in the surrounding areas also. One can best recognize these irregularities by indirect illumination from behind.

Salzmann presented many illustrations showing histological details demonstrating the development of such gaps between the epithelium and Bowman's membrane in cases of increased intraocular pressure. He distinguishes the pure, avascular superposition that has no connection with the limbal vessel system from degenerative pannus, the vessels of which can be followed to the corneal margin.

In his interesting slitlamp studies of spring catarrh, Maxwell Lyons described

very definite exudate droplets between the corneal epithelium and Bowman's membrane. This exudate is replaced gradually by proliferating connective tissue. I regret very much that until now no details about this most important fact have been reported in cases of spring catarrh.

I repeat: The normal current of the ocular fluid is directed from the surface of the cornea to the endothelium. The tiny droplets in the basal cells are small enough to pass. When the stream is interrupted (for example, by high intraocular pressure in interstitial inflammation), the droplets collect and build a fissure or even a real detachment of the epithelial layer with débris in it.

In old cases of glaucoma, Bowman's membrane sometimes looks motheaten where such an epithelial vesicle is found. *It is a kind of exudate produced between the epithelial layer and the glass membrane. At these spots we find very often a newly formed zone of fresh vessels with young connective tissue—so-called pannus degenerativus* (fig. 3).

The genesis of the other kinds of pannus is not generally acknowledged. The nourishment of the avascular cornea depends on the lacrimal fluid as well as on the pericorneal blood-vessel system. As has been proved, a specific scleral infiltration or an episcleral one in trachoma (Kreiker, Ishihara, and others) or a deep tuberculous scleritis, or congenital luetic interstitial keratitis disturbs the nourishment of the cornea and induces the assistance of new blood vessels from the conjunctival system, which creep between the epithelium and Bowman's membrane. In several papers Loewenstein has brought out the theory of the growth of pannus of various kinds (pannus trachomatosus, degenerativus, scrophulosus) as parallel—without essential differences. In recent findings—dealt with elsewhere—I observed a fatty, tongue-shaped corneal infiltration (fig. 4), associated with an adjacent scleral inflammation in rabbits fed for five months with cholesterol. Some confluent, opaque, silvery tongues corresponded with areas of progressive fatty infiltration of the whole uvea and sclera. The vessels, especially, were intensely red with Sudan IV, the content of the veins diffusely pinkish becoming red, the muscles and the perivascular tissue intensively infiltrated with shining red corpuscular lipoid masses. It is biologically very interesting that the corneal fatty infiltration was progressive so long as it was avascular. When an epaullette-pannus started to develop, the inflammatory reaction stopped as well as the increasing corneal infiltration. I could see that the origin of the different corneal fatty tongues was always in connection with a patch of scleral inflammation. The biological dependence of the corneal nourishment on the deep pericorneal vessels of the sclera seems to be proved very exactly in these experiments, as well as the "healing" influence of the growing zone of newly formed vessels at the corneal surface.

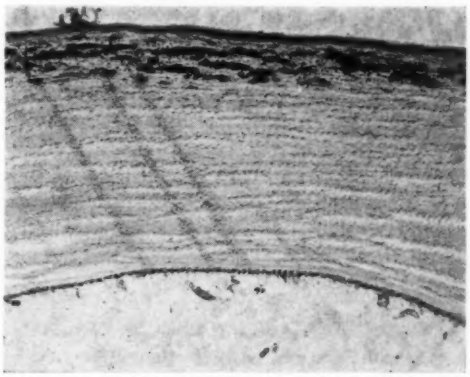

Fig. 4 (Loewenstein). Fatty corneal infiltration like a sclerotizing keratitis in the same level as the arcus lipoides (rabbit 3).

I know, of course, that there are great differences between the particular kinds

of pannus, that trachomatous pannus does not mean a clinical healing reaction, that in cases of old trachoma as well as in interstitial keratitis allergic reactions complicate the situation (Loewenstein), that with deep scleritis the newly formed vessels belong to a different brushlike deep type; but the general reaction is a parallel one, reducing the nourishment of the corneal tissue by infiltration of the perilimbal zone until a certain degree is attained. Then the clinical reaction begins—infiltration, lack of transparency of the corresponding corneal tissue with inflammation, followed by a typical vascularization of the avascular tissue.

I do not wish to speak here about the different theories of the growing pannus—the mechanical or infectious theories—as all of them are in my opinion invalid, the essential point of the question being the *scleral* affection. I do not hesitate to add that all the well-known factors—mechanical irritation and trachomatous infection of the cornea—may be added to the primary disturbance to complete the well-known clinical picture of destructive pannus, the basis of all being the perivascular or endovascular involvement.

In the case of trachomatous pannus the new vessels are proved to lie between the epithelial layer and Bowman's membrane, exactly as in the case of degenerative pannus. Later on they spread over the deeper corneal layer. It is very difficult to obtain fresh histological material that will confirm the view that there is an *exudate between Bowman's membrane and the epithelium, before the formation* of new vessels and connective tissue begins. Although I was not successful in establishing the exudate histologically, it seems to me to be probable. Tiny corneal changes, minute infiltrates at the corneal surface, are very common even in relatively fresh cases of trachoma as every experienced observer using the slitlamp will grant. The disturbance of metabolism in the corneal tissue caused by the mechanical compression of the episcleral vessels must influence the anterior-posterior current of the nourishing fluid, also, which may be stopped at the anterior border of Bowman's membrane. There the droplets of the epithelial cells gather into clefts between Bowman's membrane and the epithelial layer. The fluid content of these little vesicles attracts the conjunctival vessels from the limbus, growing to the destined layer between Bowman's membrane and the epithelium. This may be a mechanical explanation for the fact that the newly formed vessel zone starts in this layer.

However in cases in which the metabolism of the cornea has been disturbed, especially over a long period, there forms, as a rule, a new vascular layer with young connective tissue rich in cells between Bowman's membrane and its covering epithelium.

Descemet's membrane is not always altered simultaneously with Bowman's membrane, but quite often we realize that when Bowman's membrane is not sharply defined, Decemet's membrane is ill defined at the corresponding spot. In the case of nodular dystrophy of Buchanan and Michaelson, I have studied slides in which the incrustation in the parenchyma reached even to Descemet's membrane. The cross section of Descemet's membrane was deformed, the border adjacent to the anterior chamber irregular, the staining not so uniform as we usually find. Large drops of an unstained substance were everywhere to be found in Descemet's membrane. I do not believe that the thickening and chemical changes in the substance of Descemet's membrane are a *mechanical sequel* to the incrustations in the deeper layers of the corneal lamellae, although the site corresponds.

Also the disappearance of Bowman's membrane is not the result of pressure of the lamellar incrustations, as has been mentioned in various papers on this subject. Both membranes are *primarily* abnormal. It is an inherited, congenital abnormality. We do not know anything about the chemistry of the deficiency. I have observed fairly often infiltration or scars in the anterior and posterior layers of the cornea. Simultaneously with septic ulceration of the corneal surface, there is often a corresponding infiltration of the deep posterior layers. The same is often found in cases of old interstitial keratitis. I saw with Professor Ballantyne a case of corneal scars with "collar-stud"-shaped opacities consisting of gray nodules on the anterior and posterior surfaces of the cornea connected by a narrow column through the stroma. All these observations seem to contain the suggestion of a certain biological parallelism between these two glass membranes, of the differences between which I am aware, as I will stress later on. I have no knowledge of newly formed vessels between the endothelium and Descemet's membrane similar to the different kinds of pannus. They are described by Lloyd as a sequel to a birth trauma, and seem to be very rare. We will meet "pannus" productions later on in other glass membranes.

The glass membranes of the cornea have much in common, but there is a great difference between them also. The direction of living streaming fluid is from the epithelium to the glass membrane in the case of Bowman's membrane. It seems partially opposite in Descemet's membrane, that is, from the glass membrane to the endothelium—in exactly the same direction in which the nourishing fluid streams in the lens and through the lamina vitrea chorioideae. We may not of course assume that the direction of this fluid remains limited. On the contrary, a certain exchange of materials in both directions has been proved.

If, five minutes after the excision of the eye, you put a piece of fresh human cornea into a 50-percent filtered-Giemsa solution for some hours, and cut the tissue with the freezing microtome, you realize that the free edges of the section are stained reddish-blue, while the part covered on both sides of the section by the glass membranes reacts quite differently. Bowman's membrane is stained *grayish-pink,* and the superficial corneal lamellae in the same dye, with a little bluish tint, while Descemet's membrane is *steel blue. The deep parenchymatous* layers of the cornea, close to Descemet's membrane, *are deep red to purple.*

It is impossible to explain these facts except on the basis of a different special filtration of the two membranes. By this experiment, of course, it is demonstrated that the Giemsa stain permeates the cornea in the opposite direction from the one commonly accepted—within the excised cornea at least. But it is evident that different parts of the Giemsa stain—the eosin-acidophil ones—pass Descemet's membrane from those which pass Bowman's membrane. I got the same result in other experiments repeated several times —injection of 50-percent Giemsa (intralamellar) five minutes after the excision of an eye which was almost normal (in the corneal part at least). The Giemsa stain colored the central layers of the corneal fibers a purple-red. The corneal epithelium was blue, the nuclei of the epithelium a shining dark blue. While Bowman's membrane did not accept the coloring matter, it allowed it to pass through to stain the epithelium. The different chemistry of Bowman's membrane and Descemet's membrane clearly explains the well-known special staining of this membrane, especially with elastic staining. So there is no doubt that we can-

not treat both membranes alike. There is a distinction in their constitution, and we may expect the same of their function also. The permeability to Giemsa stain of these two colloid membranes seems to be different, not only quantitatively but also qualitatively. It is necessary to stress these differences, as we have pointed out their parallelisms.

A *systemic* disease of the glass membranes is not known. In the slides of the Buchanan-Michaelson case I could observe the degeneration of Bowman's membrane and its far-reaching destruction, complete in most parts of the cornea. I found a parallel but much lesser degeneration of Descemet's membrane. The lamina vitrea chorioideae of this case showed nothing else but the common senile verrucae. I observed a family with Groenouw's disease—a father and two little sons. All three showed typical changes of the cornea—the two boys central only, without diminution of function. I could study the children's fundi very exactly, No alteration was found. No systemic disease parallel to Esther Groenblad's (angioid streaks and pseudo-xanthoma elasticum) or Hurler's disease was detected. Contrary to my expectations, my findings did not show anything parallel in the skin. Perhaps another clinician will be more fortunate.

Lens capsule

There is only one organ in the living human organism that is completely surrounded by a glass membrane; namely, the lens of the eye. The lens capsule does not contain pores, as Jonas Friedenwald has demonstrated, either microscopically or ultramicroscopically. The whole metabolism of the lental tissue occurs endosmotically, and very slowly, as the whole lens capsule, completely surrounded by the intraocular fluids, functions as a highly specific filter, and the posterior part of the capsule is lacking in epithelium. It is the elastic colloidal membrane that is primarily responsible for exact quantitative and qualitative filter work. So most of the chemical changes of the intraocular fluids are neutralized by the action of the separating colloidal membrane. The higher degrees of chemical abnormality seem to influence the contents of the lens capsule like an equally strong increase of glucose, galactose, high concentration of salt solution, and so forth. But it is not improbable that this abnormality in the composition of the surrounding fluids influences the lens capsule first. The experiment of Wessely is well-known. He introduced rabbit's bile into the anterior chamber of a rabbit. The lens capsule as well as Descemet's membrane swelled up to twice their volume. So the permeability of the lens capsule became altered, and the substances entering were abnormal in quantity and quality.

I do not wish to speak here in detail about the physiological changes of aging in colloidal membranes—"histeresis"—and its connection with the origin of senile cataract (Loewenstein, Jonas Friedenwald). I would remind you of Elschnig's findings in glass-blower's cataract, the splintering of the so-called "zonular lamella"—occurring before the onset of glass-blower's cataract, the colloidal membrane at this spot being thinned.

I find it important that Vogt pointed out the great significance of the lens capsule for the nourishment of the lens. This is illustrated by the effect of certain occupations (glass-blowing, arrowmaking, iron-casting) upon the lens capsule—described first by Elschnig, Kraupa, and others, and by Vogt's senile exfoliation (Aufblätterung) of the lens capsule. The fact that the lens capsule is composed of several layers—already known to Koelliker—was proved by Vogt (1914). The lens capsule becomes brittle, and opaque,

breaks up and desquamates. This finding of Vogt is not rare, as I have seen it in old people with, as well as without glaucoma. Wiederkehr, a pupil of Vogt, distinguished three different kinds of "Vorderkapselabschilferung"—one with the dissolution of a surface lamella, another with exfoliation of the surface lamella with local thinning of the capsule, and the third the "puff-paste" dissociation of the capsular lamellae. In all his cases the epithelium histologically was not changed, as far as could be diagnosed from these slides. There may be no other explanation for this important finding of Vogt than an essential senile degeneration of this colloidal membrane.

The structure, as Vogt gives it in his Atlas, is striking and convinces us of a far-reaching senile destruction of this glass membrane—not to be confused with the so-called "fire-lamella." The connection of Vogt's "puff-paste" exfoliation of the lens capsule with the origin of cataract we do not know.

The influence of disturbances of internal secretion on the genesis of cataract has been well studied, clinically as well as experimentally. Besides diabetic cataract we recognize the lens opacities of tetany, of myotonic dystrophy, and of neurodermatitis. The clinical appearance is as I have described (Loewenstein, Nordmann, Siegrist, and others) very characteristic for these endocrine forms—a shield-shaped opacity of the anterior cortex, with a sharply defined outline composed of pointed arches. Histologically, I found in one case of neurodermatitis cataract in a five-months-old twin, who had died of paedatrophy and gastro-enterocolitis, changes of the anterior lens capsule along with keratomalacia. In several places, the cells of the epithelial layer of the lenticular capsule were puffed up and vacuolated. The epithelial layer was split in two, the intervening space containing a mass of débris with young connective tissue (fig. 5). The thin, granular exudate lying between the many irregular nuclei of the connective tissue was divided into separate masses. No defect in the capsule could be proved. There can be no doubt that these connective-tissue cells must originate in the epithelial-cell layer. The explanation for these facts may be: The disturbances of internal secretion cause a local upset in the chemistry of the lens capsule, with the result that its permeability is changed. The fluid of the anterior chamber, laden with certain substances, enters the capsule sac more easily than normally and forms a kind of exudate. The subepithelial exudate is slowly transformed with the help of the lens epithelial cells into a young-connective-tissuelike mass. Of course a vascular layer is not produced, as there are no vessels within the capsule sac at all. It is very interesting that in cases of capsule cataracts, drusenlike plaques are found, stained homogeneously, especially with van Gieson (a clear red) and with Heidenhain's Asan (a shining blue). I would call these plaques a product of

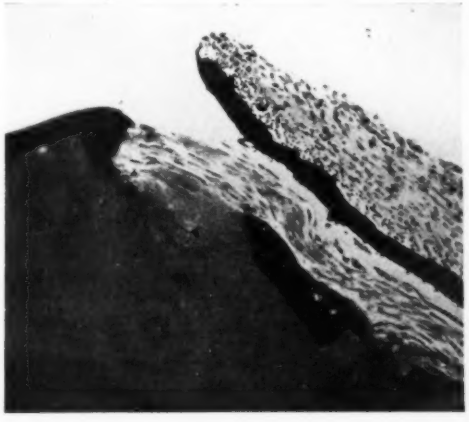

Fig. 5 (Loewenstein). Endocrine cataract with neurodermatitis. Subcapsular exudate with newly formed connective tissue. The lens-epithelium cells are splitting off backward.

the glass membrane analagous to the colloid bodies of the lamina vitrea chorioideae (to be described later). Peters believed that a fluid permeating from the anterior chamber is the cause of this drusenlike colloid tissue. Droplets between the epithelial cells in the case of

Fig. 6 (Loewenstein). Elastic lens capsule rolling up after loosening of tension.

cataract are well described in von Hess's "Text-book of lens diseases." It cannot be determined whether these droplets are a secondary degeneration of epithelial plasma—lying as they do between the cells—or if the droplets collect pathologically, percolating too quickly through the lens capsule from the surrounding fluids. I stress the analogy with the facts described in the corneal section of this paper—the exudate between the epithelium and Bowman's membrane, the producing of a young connective tissue between the glass membrane and the epithelial layer.

The lens capsule always remains under a high tension. We do not know whether this tension is greater in the lens of young persons. Perhaps the elasticity of this membrane itself is of importance for the change of lental refraction, as well as the sclerotic process of the lenticular sac content. At any rate, in traumatic cataract in juvenile eyes we observe histologically that the lens capsule coils upon itself like a spiral spring, when the contents of the capsule escape (fig. 6). This fact demonstrates very clearly the great demands made on this elastic membrane throughout life. Its wear and tear are unavoidable.

Experiments with rats fed on galactose (35 percent of the food) have produced the well-known galactose cataract. Mitchell and her collaborators had already proved that a higher permeability of the lens capsule is produced by galactose intoxication, with a disturbance of the osmotic equilibrium. The rough clinical examination of rats fed on galactose shows that the first opacities are seen in the depth of the lens (Kirby, Mitchell, Sasaki); but just within the last few days Yudkin and Geer have published the fact that four to seven days after starting their experiments subcapsular vesicles filled with fluid appeared before the substance of the lens became opaque. The so-called "sun-flower" cataract, demonstrating the presence of an intraocular copper splinter, is anatomically situated (Jess) in a layer between the lens capsule and the epithelium. The copper salts permeate the damaged lens capsule and gather between this colloidal membrane and the epithelial layer.

The colloidal membrane of the lens capsule regulates the metabolism of the lental fibers by controlled, directed filtration. Structural capsular changes owing to age or by chemical influence produce a change in the metabolism of the cortical fibers, with loss of their transparency and later disintegration. The formation of a subcapsular exudate with subsequent growth of young connective tissue could be demonstrated in an early endocrine cataract.

Part II will be published in the next (December) issue; it will include the bibliography.

PRACTICAL SKIASCOPY

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Looking into an eye from the usual distance for direct ophthalmoscopic examination, we see an erect image of the fundus. If a strong convex lens is placed before the eye, as for indirect ophthalmoscopy, or upon looking into an eye that is very myopic, we see an inverted image of the fundus. Skiascopy is an accurate method of determining whether the image is erect or inverted. The erect image is a virtual image located behind the eye; the inverted image is in front of the eye, formed at the far point of a myopic eye, or eye rendered myopic by putting a convex lens before it.

These images are to be observed in the pupil. Theoretically the image observed by the direct method of opthalmoscopy is a large image situated behind the eye. The image observed by the indirect method is formed in front of the eye by rays from the retina that have been made convergent by the crystalline lens and cornea of the myopic eye, or by the convex lens that has been placed before the eye to form the inverted image. In both cases the image is at the conjugate focus for the retina. This is the far point of the myopic eye, or the eye rendered myopic by a convex lens. At this conjugate focus the rays from any given point of the retina are brought together, forming an image of that retinal point. There the rays cross each other and their relations are inverted, causing the apparent inversion of the image. Skiascopy is a method of fixing accurately, the point of this reversal. It is the most accurate objective method of measuring refraction, if the conditions for its accuracy are understood and carefully observed. It tests the refraction of only one point of the retina. But if this point is in the macula, subjective testing can do no more. It is the best check for the results of subjective refraction in every case.

For skiascopy we watch the movements of light and shadow in the pupil. This movement is made by turning the mirror held before the observer's eye. By turning the mirror the area of light reflected on the face is caused to move with the movement of the mirror. The light image in the pupil is also moved by turning the mirror. If the light in the pupil moves the same way as the light on the face, we are looking at an erect image in the pupil; if the light in the pupil moves in the opposite direction, we are seeing in the pupil an inverted image. The distance at which the change of one movement to the other occurs is the point for which the eye is focused. Measuring the distance of that point from the eye, we know the amount of myopia that the lens before the eye has caused. Knowing the focusing power of that lens, we can know the lens effect of the refracting surfaces of the eye.

At the point for which the observed eye is focused, the light we have to watch will come from a single point of the retina, magnified to occupy the whole width of the pupil. This makes the light in the pupil very weak; and it may be impossible to see how the light does move. The best we can do is to find a point nearer the eye where the erect image and movement of light can be recognized; and another point farther away from the eye where the inverted movement can be recognized. Between these points is the point of reversal, the "far-point" that gives the refraction of the eye. To recognize

movement close to the point of reversal, a bright light is required; and as the movement across the pupil is very swift, it must be closely and continuously watched to see in which direction it does go. To have the light as bright as possible at the point of reversal, the light reflected into the eye must also be close to the point of reversal. This is secured by having the point of light close to the mirror that reflects it.

When regular astigmatism is present, we have to consider two points of reversal; the principal meridians of astigmatism give reversal at different distances from the eye. The most accurate determination can be made when the observer's eye is at, or near, the point of reversal for one meridian, and the image of the point of light is at the point of reversal for the other meridian. In using the plane mirror the observer's eye should be at the point of reversal for the meridian of least refraction (greatest hyperopia, or least myopia), because the image of the source of light is then farther from the patient's eye. When the concave mirror is used, the source of light is an image formed by the mirror, closer to the patient's eye; and under that condition, the meridian of least hyperopia, or greatest myopia, can be most accurately determined. With a cylinder correcting the astigmatism, the two meridians are brought to a focus, at one distance from the eye; and the mirror should be close to the source of light. The practical way to use skiascopy is first to determine approximately the position of the point of reversal. Then notice if there are two points of reversal, the direction of the meridians, and about where they are. Then place a cylinder which you think will correct the astigmatism. If some astigmatism remains, find how much it is, and its direction. After the astigmatism is corrected, retest for the amount of hyperopia or myopia.

In nearly all eyes skiascopy shows evidence of aberration, like the spherical aberration of lenses. The rays passing near the periphery of the pupil are more refracted than those passing near the center. This kind of aberration is least near the center of the pupil, and greatest at the margin. Generally there is a visual zone, a circle of about 4 mm. in diameter, at the center of the pupil, which is practically free from aberration. This is the part of the pupil that is most important for measuring and correcting errors of refraction. In the strong outdoor light, or when looking at near objects, the physiologic contraction of the pupil excludes the aberration that is generally evident in a dilated pupil. Attention must be fixed on the "visual zone" in doing skiascopy, and, for subjective testing of refraction, the final decision must be made after the pupil has recovered from the effect of any mydriatic. For young children skiascopy is the method most to be relied on. In elderly persons, accustomed to reading, subjective testing, the use of a cross cylinder, is more generally important.

For either, a pupil of 3 or 4 mm. diameter is most satisfactory. This is large enough to allow sufficient light to pass in and out through the opening but excludes the periphery of the dilated pupil, where the more puzzling movements of light and shadow are mostly encountered. Even when the refraction has been carefully measured, and the patient realizes the help obtained from his glasses, many patients notice that they see better without glasses in a dim light. This generally means that, with the pupil somewhat enlarged, the periphery of the pupil has become somewhat myopic. This may be avoided by giving an incomplete correction for the hyperopia. But, if the

patient really needs a full correction, it is better to advise his working by a stronger light, which will secure contraction of the pupil at the time the correction of the error is most needed.

Increase in the size of the pupil enables the examiner to recognize the movements of the skiascopic image at a greater distance; but it introduces the element of aberration, making the test less reliable. If, instead of a 4-mm. pupil, we have the pupil 6 mm. in diameter, the addition of 1 mm., all around, increases the visibility of the light moving in the pupil. But the area increasing as the square of the diameter, the 4-mm. pupil gives area 16, and the 6-mm. pupil, area 36. More than half of the light coming from the dilated pupil comes from the added strip of relatively myopic refraction. With a pupil 7 mm. in diameter twice as much light would be coming from the "extra-visual zone," as from the visual zone. Such patients can see better without their glasses at night. The use of pilocarpine, in the evening, may help with the glasses.

The best size of pupil for skiascopy can usually be obtained by regulating the light in the room where the examination is made. In young patients the pupil can always be contracted by the general lighting of the room; and skiascopy can be practiced, from a relatively near point, in a room quite moderately illuminated. In a few patients at any age, and in rather more elderly persons, the pupil cannot be dilated to 4 mm. by any mydriatic. The best drug for the purpose is cocaine in weak solution. But in some eyes the iris is so rigid that nothing will secure a 3-mm. pupil. What little can be done by skiascopy, in such cases, must be from a point close to the eye, perhaps within one-quarter meter from it.

The usual distance between the observed and observing eyes should be one meter or less. It is easier to notice the distribution and movements of light and shadow at one-half meter than at double that distance. Some of the older accounts of the test advise its application at 4 meters. At such a distance it is possible to observe only a general movement of light and shadow in the pupil; and this will be dominated by the light that comes from the wider periphery of the pupil. If the light from the 4-mm. visual zone is designated by 16, the light from the 9-mm. dilated pupil will be 81. Only one fifth of that light comes from the visual zone. To see all we need to observe by skiascopy, the pupil has to be fully dilated. But it should be viewed from the usual short distance to assign to the different appearances in various parts their proper significance and importance. In high irregular astigmatism, whether it be from phlyctenular disease in early life or from the lens changes of beginning senile cataract, there may often be found a part of the visual zone that is fairly regular. When this is observed from a distance of one-fourth meter, it is possible to give the patient the full service of an optical correction of which his eye is capable.

Skiascopic diagnosis, like diagnoses in general, should rest on the broadest basis of accurate observation. A mathematical understanding of it may be essential. Mathematics furnishes the explanation for the greater part of optical phenomena. But the physician who attempts to apply optics must not ignore the importance of the widest experience and the most exact observation. Practical skiascopy requires that each case of refractive error should be thus investigated from all points of view. When he looks into an eye, the physician should be familiar with the appearances that may be presented by all kinds of errors of refraction.

The differences of refraction as meas-

ured in different parts of the fundus are often overlooked. An experienced ophthalmologist, accustomed to use skiascopy, was completely puzzled by the fact that, looking into the eye in the direction of the macula, he found a myopia of 4 D. But when the patient looked elsewhere, turned his eye somewhat, the movement suddenly became that of hyperopia. The doctor had not observed that, in the highest degrees of myopia, the anterior segment of the fundus is hyperopic. Emmetropia and perfect correction of refractive errors is possible only for the small area in and immediately around the macula. In doing accurate skiascopy it is essential that the observed eye should look, not at the source of light reflected in the mirror but close to that direction, as past the ear of the observer, or be fixed on some object across the room, in that direction.

Skiascopy is the only objective method of determining whether there is complete abeyance of accommodation. After the refraction has been measured and lenses placed before the eye that will bring the point of reversal exactly to the observing eye, the light and shadow in the pupil should be carefully noted. Then the point of a lead pencil, or some similar object, is held close to the eye of the patient, who is told to look at it. The movement of the other eye will show the strong convergence. If there remains even a small remnant of accommodation in the observed eye, it will show a change in the pupillary illumination. Repeated a few times, the observer will thus be convinced that the accommodation is, or is not, completely paralyzed.

Skiascopy is a practical method of measuring refraction. It is an objective test, more exact and more informative than the refraction ophthalmoscope, or the ophthalmometer. It requires very little special apparatus, and it reveals the state of refraction in each particular part of the pupil. It can be relied on for uneducated, ignorant patients; and for young children before they can be accurately tested by subjective methods. Bowman directed attention to it in 1862; Donders called attention to it two years later; and 10 years after that the French ophthalmologists began to rely on it as a practical method. Intelligent practice with it, alone, can give skill. But it is a method of diagnosis that no intelligent ophthalmologist can afford to disregard.

The following case illustrates the practical value of skiascopy. A teacher, who had worn glasses many years—full corrections worn constantly—came with the statement that she always took them off at the movies. There was some change in the astigmatism, for which she was given in July, 1939: R. +4 D.sph. ⊂⊃ −2.50 D.cyl. ax. 100°; L. +4.50 D.sph. ⊂⊃ −2.50 D.cyl. ax. 90°.

The addition for near work was R. and L. +2 D.sph. These were satisfactory, except that she still had to take them off to see the moving pictures.

In March, 1940, it was found that with light reduced, as at the movies, her pupils, instead of being 4 mm., were 6 to 7 mm. in diameter. Skiascopy showed in the edge of each dilated pupil positive aberration, reducing the hyperopia a whole diopter. The patient was given glasses with the convex sphericals reduced 0.50 D. for each eye; and wore them at the movies with satisfaction. Attention was first called to the "asymmetrical aberrations of the eye" in a paper read before the American Ophthalmological Society in 1888.

GENERAL HYPERTENSION AND PERIPHERAL OPTIC PATHWAYS*

JOSEPH IGERSHEIMER, M.D.
Istanbul, Turkey

I am greatly honored by your kind invitation to speak before the famous American Academy of Ophthalmology and Otolaryngology. It is a favorable coincidence that the principal topic of your meeting concerns the relations between general hypertension and diseases of the eye and ear. Since for the past several years I have been occupied with the study of such relations, I hope to be able to add a few new points of interest.

Although science and practice have been occupied for many years with the reaction of the retina and the choroid in vascular diseases involving the blood pressure, the part played by the optic nerve and the chiasm in these processes has been neglected.

The literature on this subject is very meager, and I shall, for the most part, make use of the results of my own researches. In order to keep this report within convenient limits, I wish to point out only the principal results of my research, omitting nearly all references to literature and the details of my observations.

Though the amount of material I have examined is large, it still is not large enough to establish definitively the correctness of the grouping and concepts I now present. Many more observations will have to be collected, and I regard this as only a basis for further research and for discussion.

In many cases, unfortunately not in all of them, it was possible to compare the clinical with the anatomic state. For the histologic examination the optic nerve was cut into many pieces, so that different methods of imbedding and numerous methods of staining might be employed.

THE PROCESSES IN THE CONNECTIVE TISSUE

Although the changes which I have observed in the connective tissue of the optic nerve have in the majority of cases no great clinical importance, I still want to mention them, since they give us certain clues; also, because one may not yet realize their importance for the understanding of the pathological occurrence in the hypertensive diseases.

It is not my intention to speak at length about the changes in the walls of the central artery and vein of the retina. They are doubtless frequently to be found in patients with hypertension, but have no bearing on the typical consequences of hypertensive diseases; as, for example, retinitis albuminurica. In several cases I observed a localized proliferation of the axial fasciculus in the neighborhood of the central artery. This apparent proliferation of connective tissue had nothing to do with an edema. I think it quite possible, however, that it had something to do with a condition that can be brought into relation with arteriosclerosis. This point of view was maintained by Hueck, who did not limit the changes in arteriosclerosis to the walls of the vessels, but also included the surrounding connective tissue.

The microcellular infiltration in the axial fasciculus, of which mention has already been made, was traceable in some

* Read (by invitation) before the American Academy of Ophthalmology and Otolaryngology, at Chicago, October 9, 1939.

other observations in cases with retinitis albuminurica as well as in cases without retinal changes. It is of special interest that this infiltration was localized not around the vein but usually around the artery (fig. 1). The artery is, however, not always diseased. Special attention was given to the small vessels of the septa and of the pia of the optic nerve. In systematic examination of a larger number of cases, an unusual method of imbedding in paraffin was used to obtain sections as thin as possible, and in order to scrutinize the smaller vessels more accurately.

The processes in the nerve tissue itself

The changes which were noticeable here were mainly of a degenerative nature. The principal question is, however, where this degeneration develops first. It does not seem to be true that the optic nerve undergoes only an ascending degeneration, as a result of the retinal process. This point of view was apparently held until now, and therefore the changes in the optic nerve were regarded as uninteresting.

(a) *Ascending degeneration.* It is certain that in retinitis albuminurica an ascending degeneration of the optic nerve is possible. But on the ground of microscopic research it must be admitted that only certain cases of retinitis albuminurica show such consequences in the optic nerve; further, that these consequences are absent just when one would expect them most. The fact is really very astonishing that a papillo-retinitis albuminurica of severe character can exist for a long time and produce either no degeneration of the optic nerve or cause it late and in a mild form.

Case 1. I shall present a case of papillo-retinitis in a 38-year-old patient. The condition was present when he came to the hospital for the first time, and seven months later when he was again admitted, it was still more extensive. A severe uremia also was present—the arteries were as thin as threads and the veins as if interrupted. The patient died from an apoplectic stroke. Microscopically there was a characteristic papillo-retinitis albuminurica with a moderate arteriosclerosis of the retinal vessels. Important for our discussion here was the state of the optic nerves.

The optic-nerve trunk of the right side showed a very small limited defect, which could be traced right into the intracranial optic nerve (fig. 2). It is noteworthy that this small peripheral degeneration corresponded to the nasal part of the retina, in which much less change was to be seen than in the temporal. Also in the left optic nerve, a very small part of the nerve fibers in the periphery of the retrobulbar section was paler. With the Marchi staining method, which shows up the earliest stages of degeneration, no degenerations were to be seen.

Case 2. Even more striking was the clinical and anatomic evidence found in a 40-year-old patient, who, 10 years previously, had some trouble with his kidneys accompanied by edema. A year ago, he had another attack and after a few months it was noticed that his visual powers had decreased considerably. Lately he has been almost blind. His blood uremia was 428 mg. percent, the blood pressure was elevated, and very considerable quantities of albumen were present in the urine. Ophthalmoscopically, an unusually severe retinitis was seen which in parts resembled a detached retina, but had changed the whole posterior fundus into a yellowish mass with hemorrhages.

Histologically, apart from a very heavy fatty infiltration of the retina, an enormous edema was found. The changes were more marked than I have ever seen (figs. 3, 4). In contrast to this, on one side of the

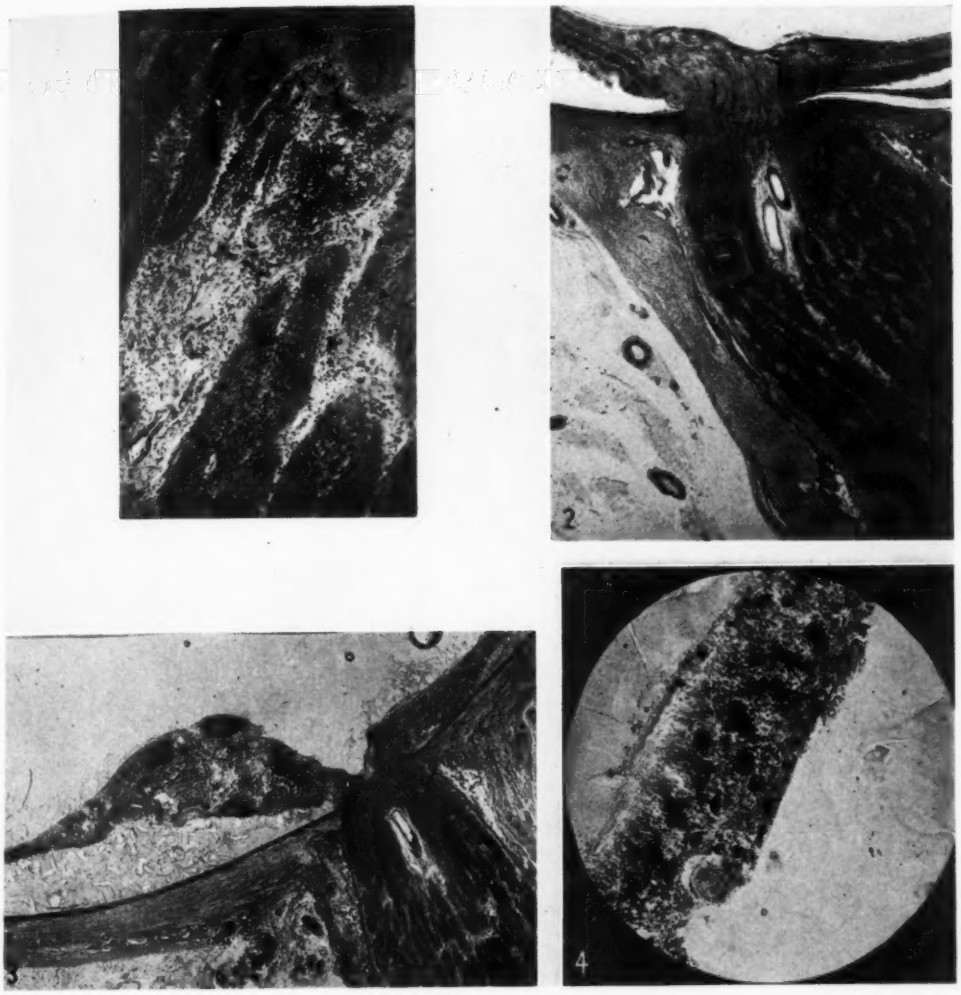


Fig. 1 (Igersheimer). Microcellular infiltration in the fasciculus axialis of a patient with general hypertension, mostly around the arteria centralis retinae. Retina, choroid, and optic nerve show no other signs of disease.

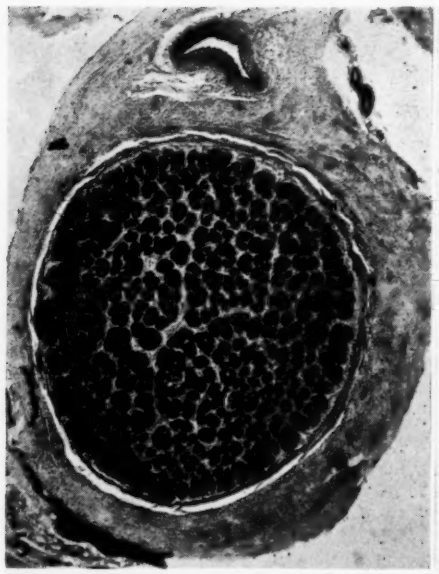
Fig. 2 (Igersheimer). From a thirty-eight-year-old patient (malignant hypertension) with high-grade papillo-retinitis of about a year's duration nevertheless with only slight peripheral ascending degeneration of the optic nerve.

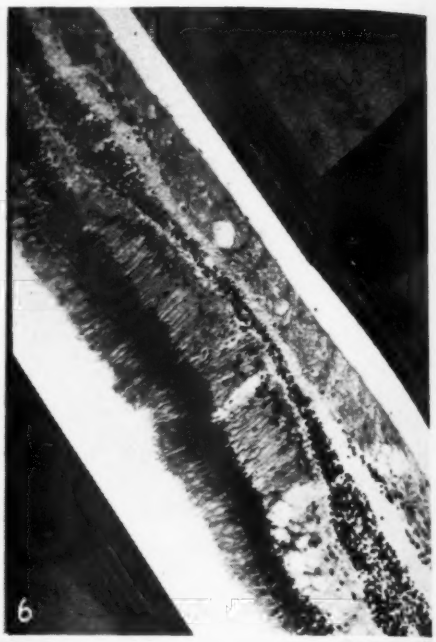
Fig. 3 (Igersheimer). From a forty-year-old patient (chronic glomerulonephritis) with high-grade retinitis albuminurica and enormous edema of the retina near the disc.

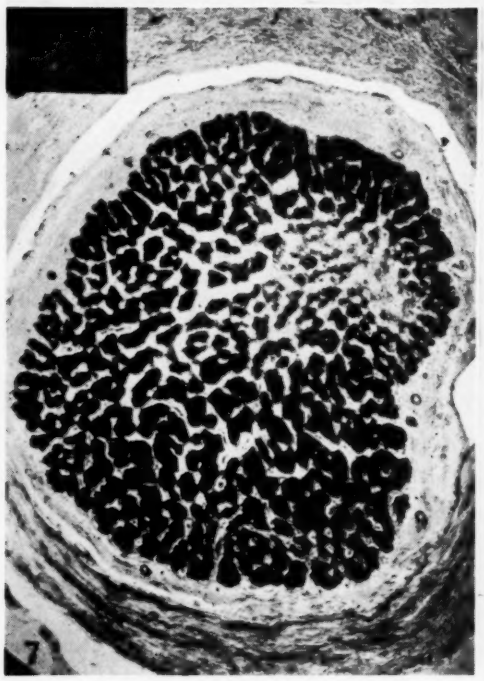
Fig. 4 (Igersheimer). From the same patient as in figure 3. High-grade fat infiltration in the retina.

optic nerve there was only a paleness of some peripheral fiber bundles, the character of which was not definitely revealed to be degenerative (fig. 5). In the other optic nerve there was a small degree of degeneration of some peripheral bundles which disappeared toward the middle of the orbital portion.

From these two cases the conclusion is justified that in a retinitis albuminurica which may even be very severe, one does not always find degenerative changes in







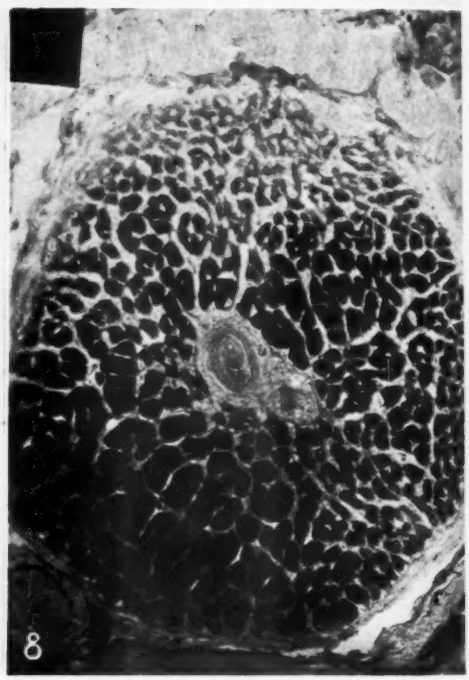


Fig. 5 (Igersheimer). From the same patient as in figures 3 and 4. In spite of the high-grade retinitis and of blindness the optic nerve shows almost no signs of degeneration.

Fig. 6 (Igersheimer). From a seventy-six-year-old patient with severe general hypertension. Clinically: mild retinitis, normal disc; histologically: changes in the inner layers of the retina with closed small vessels.

Fig. 7 (Igersheimer). From the same patient as in figure 6. Degeneration in the optic nerve.

Fig. 8 (Igersheimer). From a sixty-six-year-old patient with malignant hypertension. Endarteritis of the arteria centralis retinae without total obstruction. Degeneration of the optic nerve.

the optic nerve. They may be completely absent or sometimes present to a mild degree. This may be so, although the condition had been present many months or even longer than a year.

The second fact which appears of interest in the question of ascending degeneration is that in certain kinds of retinitis secondary atrophic changes occur in the optic nerve which, however, may remain latent ophthalmoscopically as shown in the following observation:

Case 3. A 76-year-old patient was admitted to the hospital because of severe hypertension and marked cerebral sclerosis. She showed a moderate retinitis with thin arteries and normal papilla. Microscopically only the right side could be examined.

In the retina some albuminuric exudates were found in the outer layers; in the inner layer here and there longitudinal cavities and in some places lacunae of the layer of ganglion cells. The small vessels of the retina were partially thickened and closed (fig. 6). In the optic nerve there existed a continuous fairly widespread degeneration (fig. 7) which, in the anterior region, was situated more in the peripheral part of the cross section, and farther back more in the central part.

In contrast to the severe changes in the retina described above, in this case ophthalmoscopically there was only a mild retinitis. In spite of this there was a most definite degeneration of the optic nerve due to the destruction of large portions of ganglion cells, in all probability caused by the diseased arterioles in the retina. The result insofar as the clinical examination is concerned is that we cannot foretell ophthalmoscopically in how far a process in the retina leads to destruction of the innermost layer and therewith to an ascending atrophic process in the optic nerve. This explains the serious visual deterioration in some seemingly mild cases of retinitis. It is also doubtless of clinical interest that very definite atrophic processes go on in the optic nerve which do not manifest themselves by pallor in the optic disc.

(b) *Independent processes in the optic nerve.* We have seen in the last paragraph that not infrequently one can witness a certain incongruity between the severity of affections in the retina and processes in the optic nerve. We sometimes had the impression that the degenerative optic nerve process was of a secondary ascending nature. Now there are observations of mild retinitis without an extensive disease of the retinal arterioles, but in spite of this there is still a definite atrophic process traceable throughout the whole optic nerve.

In such cases the question arises whether the process of degeneration in the optic nerve is not independent of the affection in the retina. There was support for such a belief in several of my observations in the fact that the intensity and extent of the degenerative processes in the optic nerve were strongest a few millimeters behind the bulbus and decreased posteriorly as well as anteriorly. In any case, such observations cannot be used for our question with absolute certainty. But a case which I shall describe later on, in which a retinitis was combined with an affection of the chiasma, is absolute proof for the above point of view.

Apart from the possibilities just mentioned I have, during the course of my examinations, observed various pictures the origin of which can scarcely be ascribed to anything but the conducting visual path. I mention them here in the form of several groups without intending to say anything definite about their origin.

As to the first group, I wish to discuss the question, whether there are primary lesions in the optic nerve that might be

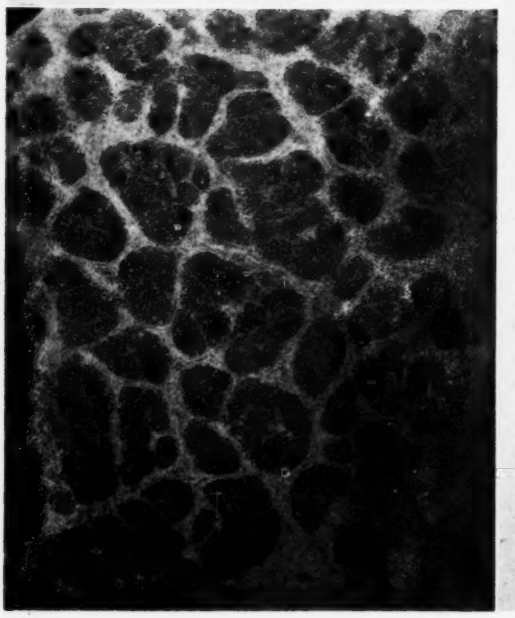


Fig. 9 (Igersheimer). From the same patient as in figure 8. A section several millimeters behind that shown in figure 8. The central artery itself is almost normal, but a small vessel (probably a branch of it) is closed.

Fig. 10 (Igersheimer). From the same patient as in figures 8 and 9. Fatty degeneration of small vessels in the atrophic area.

Fig. 11 (Igersheimer). From the same patient as in figures 8, 9, and 10. Fatty degeneration of small vessels in the normal optic nerve of the other eye.

Fig. 12 (Igersheimer). From a 49-year-old patient with malignant hypertension. Rapid atrophy of the optic nerve. Increase of the glia cells in the disc.

connected with disease of the arteria centralis retinae, of course, without the clinical picture of embolism.

Illustrations will be shown from a 66-year-old woman who had hypertension with some uremia and who died of an apoplectic stroke. There existed a mild retinitis and both optic discs ophthalmoscopically were slightly edematous, but not pale. Microscopically, a definite arteriosclerosis was to be seen in the inner layer accompanied by blocking of the minute vessels of the retina. Now the interesting point is that the right optic nerve showed marked degeneration, whereas the left was not at all degenerated. I am inclining to the view that the degeneration in the right nerve is to be related to changes in vessels within the optic nerve. This point of view is favored by the following facts:

1. In spite of similar processes in the retina the atrophy of the optic nerve was present only in one eye. (By the way, just in that eye in which ophthalmoscopically there was less involvement of vessels.)

2. On the side where the optic nerve was atrophied, the intensity of the degeneration was maximal a few millimeters behind the bulbus and could be traced to the optic disc in only a small part.

3. On the diseased side there existed some disease of the arteria centralis retinae, which had certainly not brought on the optic degeneration by itself, since neither clinically nor anatomically were there evidences of a blocking of the central artery (fig. 8). However, this disease had spread to some branches in the optic nerve (fig. 9). In any case the severe endarteritis of the small vessels in the axial fasciculus is probably related to the disease of the main vessels. It is unlikely that these small vessels should have caused the atrophic changes at the edge; but since in addition there were some vessels with fatty degeneration in their walls, it may be thought, considering the foregoing arguments, that the degenerative process had started in the optic nerve itself (figs. 9, 10). However, one must admit that fatty degeneration of the walls in smaller vessels in the septa and neuroglia by no means always causes such a degeneration in the nerve tissues.

Rapid Necrosis of Nerve Substance. A rapid decay of visual functions, which is definitely to be related to processes in the optic nerve, occurs occasionally in malignant nephrosclerosis.

I was fortunate some time ago to observe and to examine anatomically a particularly characteristic and explanatory case.

Case 4. A 49-year-old patient who had been luetically infected many years ago was absolutely well till suddenly a mist developed in front of both eyes. A neuritis optica was diagnosed by an eye specialist. In the next two weeks some retinal hemorrhages and a commencing star figure were added to the findings. The vision decreased rapidly. Two weeks later the patient was practically blind. From the internal point of view there existed only a general hypertension. The spinal pressure was not increased. The patient died four weeks after the beginning of the eye trouble as the result of cerebral hemorrhage.

In this case of typical malignant nephrosclerosis the fact to be noticed most was the sudden decay of the optic-nerve tissue, which had spread to all the bundles of the optic nerve (figs. 12, 13). The processes in the retina were so minimal that there was no question of an ascending degeneration. On the other hand no trace of a descending degeneration from the chiasma downward could be found. It is very probable that the process started within the optic nerve, but it is not

possible as yet to say how it came about.

The rather obvious conclusion that the degeneration was attributable to disturbances of circulation inside the optic-nerve trunk could not be confirmed by anatomic examination. However, on the other hand, it is to be assumed that in consequence of circulatory changes the drainage of lymph in the optic nerve was made more difficult and that the small amount of damming in the optic disc is to be connected with this, since a raised intracranial pressure was not found.

The ultimate reason for the rapid decay of the optic-nerve tissue is therefore not clear. But it is to be assumed on fairly good grounds that a serious disturbance of circulation in the smallest vessels of the optic nerve were causing these processes.

In the literature I found another observation, made by Raubitschek (1914), which clinically resembles the above case in many respects, but which could not be examined anatomically. It is a case of severe prominent papillitis with functional disturbances in a patient who had hypertension. After two days this papillitis receded with whitish discoloration of the optic disc and greatly constricted retinal vessels first in one, then in the other eye. Although the visual acuity improved, it was permanently reduced. At the time a local process in the optic nerve was suggested.

Glaucomalike Cupping in Consequence of Retrobulbar Processes. Among my anatomically examined cases there is a very interesting observation that is pertinent to the discussion of the question, how far a retrobulbar degeneration of the optic nerve can exist in relation to a general hypertension, and how far it is able to produce a glaucomalike cupping of the papilla.

Case 5. A 42-year-old patient who had a secondary contracted kidney, with an elevated blood pressure, and finally an extremely high blood nitrogen showed a physiological excavation of the optic cup at the beginning of an observation period of a year and a half. This apparently physiological excavation changed during this time into a glaucomalike cupping.

The microscopic examination showed almost no localized changes of the retina. On the papilla there was a deep excavation. In the lamina cribrosa and behind it were small cavernous areas of Schnabel and a localized atrophy which could be followed posteriorly only with difficulty (figs. 14, 15). Single vessels were without changes. Here and there a few small vessels in the pia and in the septal tissue were thickened. Also on the right side there was a retrobulbar atrophic area.

The main process in both eyes was undoubtedly situated behind the globe, and now it is a question whether such a retrobulbar process in the optic nerve can be correlated with a general hypertension.

It would be of great value if some concepts presented in the literature could be verified. Morax says that the cavernous areas of Schnabel are due to a vascular obliteration of the small vessels. Scheerer speaks of necrosis of the laminar vascular net, which would be possible in cases of arteriosclerosis. Interesting as these concepts of Morax and of Scheerer are, they are based on no real facts; mere theoretical ideas led them to their convictions.

Siegert also, on the basis of an observation, inclines to the opinion that local circulatory disturbances in the anterior part of the optic nerve are of major importance.

In quite a different connection Koyanagi mentions that in cases of retinitis albuminurica nearly all of several small branches of the vascular net of Zinn, which are of great importance for the nourishment of the papilla and the

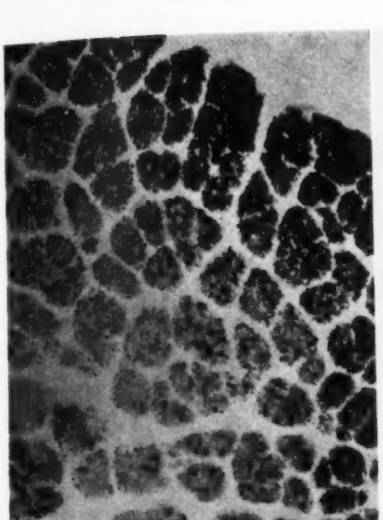


Fig. 13 (Igersheimer). From the same patient as in figure 12. Fresh degeneration of the optic nerve (Marchi impregnation).

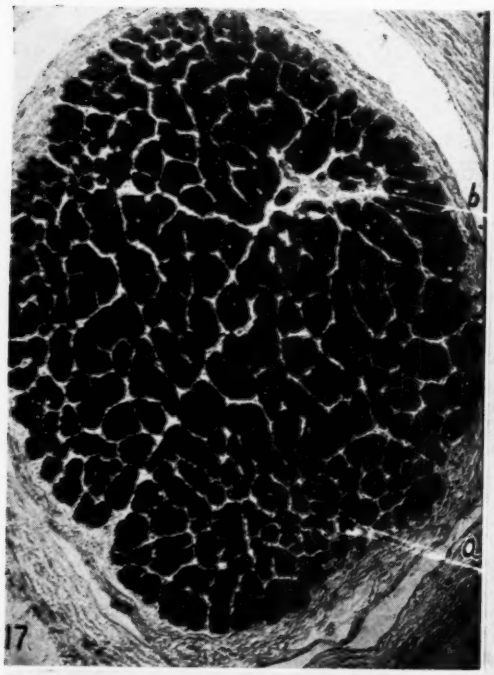
Fig. 14 (Igersheimer). From a forty-two-year-old patient with secondary contracted kidney. Glaucomalike cupping (right eye). Retrobulbar atrophic sector.

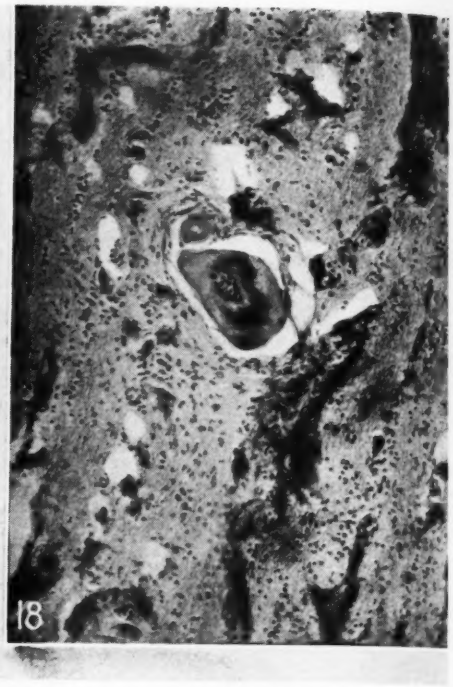
Fig. 15 (Igersheimer). From the same patient as in figure 14. Glaucomalike cupping (left eye) with myopic conus. Retrobulbar atrophic area.

Fig. 16 (Igersheimer). From a twenty-six-year-old patient with general hypertension. Histologic changes in the retina typical for retinitis albuminurica.

surrounding retina, showed hypertrophical or degenerative changes.

In my own observation it was of great interest that the glaucomalike cupping developed while the patient was in the care of the ophthalmologist. In all probability





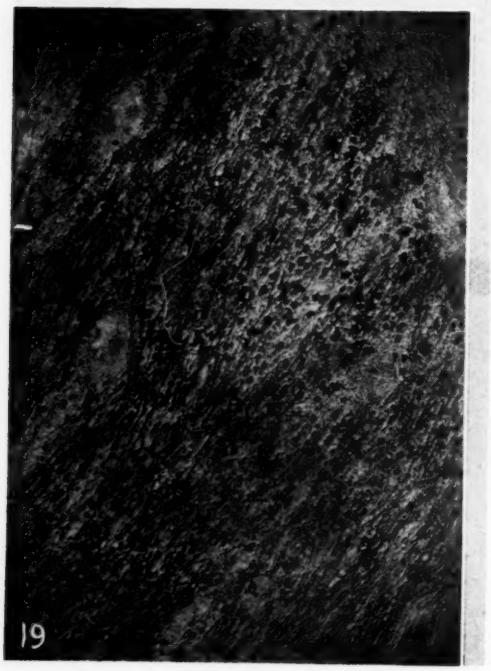


Fig. 17 (Igersheimer). From the same patient as in figure 16. Two small areas of degeneration, one probably ascending (a), the other probably descending (b).

Fig. 18 (Igersheimer). From the same patient as in figures 16 and 17. Very definite changes of some small vessels in the optic nerve.

Fig. 19 (Igersheimer) From a 38-year-old patient with papilloretinitis albuminurica (the same patient as in figure 2). Cordlike degeneration in the chiasma (the black spots caused by fatty degeneration of the nerve fibers).

the localized degeneration at the anterior end of the optic nerve was caused by disturbances of the circulation which were referable to the general hypertension. Yet the histologic examination gave insufficient evidence for that.

Our observation is therefore inadequate to answer the former question but, on the

other hand, it directs one's attention to a probable connection of a glaucomalike cupping (especially in the case of glaucoma without rise of intraocular pressure) with degenerative retrolaminar processes which, in their turn, are probably due to organic or functional changes in the small vessels of the nerve.

(c) *Descending degeneration.* Another question is whether sclerotic small branches of the carotids are able to produce a disturbance of the nourishment of the intracranial opticus or of the chiasma. At times this possibility has been pointed out, especially by Henschen. The oft-cited observation of Henschen is very complicated and, aside from the fact that general hypertension of the patient is not mentioned, it cannot be brought as evidence for the question under discussion. Up to the present there can be no certainty on this point.

In the remaining portion of this discussion I will refer to clinical and anatomic observations which concern the chiasma and which make it more than probable that degenerations in hypertensive patients can start in the chiasma.

Case 6. First, a very interesting case of a 26-year-old woman who was observed for three years and who could be examined anatomically. In 1936 she showed a typical retinitis albuminurica, a peripapillary edema, thin retinal arteries, high general hypertension, albumin in the urine, no uremia, and normal vision.

A year later there was no change of the fundus, but a decrease of the formerly normal vision to the perception of fingers at 1 meter, and there was now a slight uremia (79.3 mg. percent).

Again a year later, after intensive internal treatment, the edema of the fundus had disappeared, but there still were exudates and a star figure in the macula. Vision was R.E. 5/50, L.E. 5/30. Now one could definitely distinguish a bitemporal hemianopic scotoma.

Another year later the patient was in a very serious general condition. The uremia was 330 mg. percent, and the condition of the eyes had hardly changed.

The histologic examination of the eyes showed a typical retinitis albuminurica (fig. 16). In the optic nerve there was (1) a slight degeneration of some bundles near the margin of the cross section, possibly caused by retinitis; (2) on both sides a small portion of total degeneration, very probably caused by the chiasmatic process; (3) disease of small vessels, which can seldom be demonstrated so clearly (figs. 17, 18).

This observation has a special interest for us because the bitemporal hemianopic scotoma, clinically observed, proves that a retinitis albuminurica can exist, and independently of it a process in the optic pathway. How this process in the chiasma developed cannot be stated, for the chiasma itself could not be examined.

That separate changes in the chiasma can be found histologically was briefly reported in a previous publication. In two cases of papilloretinitis albuminurica, a little cordlike degeneration was demonstrable in the chiasma by scarlet-red staining and this degeneration could not be followed farther on towards the nerve and the retina (fig. 19). In view of the general symptoms as well as of the prominence of the disc, it was probable, in these two cases, that the intracranial pressure was elevated. Therefore, besides the circulatory disturbance induced by the small arteries, one must think also of the possibility that the elevated intracranial tension had influenced the chiasma.

In my opinion the elevated intracranial pressure as a pathogenetic factor has to be taken into consideration, because in a case of early choking due to tumor I saw a similar change limited to the chiasma.

In any case the conception seems to be

justified that, on the basis of general hypertension, now and then changes in the chiasma occur which can lead to a descending degeneration of the optic nerve.

Conclusions

The changes in the optic nerve and chiasma in patients with high blood pressure are discussed. No details are given concerning processes at the papilla, of which a great deal could be said.

The pathologic processes in the *trunk of the optic nerve* and in the *chiasma* in cases of general hypertension (mostly in cases of malignant hypertension) are more frequent and more variable than is generally believed, and they warrant more attention.

It remains an open question whether the alterations in the connective tissue as lymphocytic infiltrations around the central artery and in the septa (?) or peculiar proliferations of the connective tissue in the axial fasciculus are intimately connected with the general hypertension; they were mentioned because I saw them several times in varying degrees and because they demonstrate that behind the globe changes occur which we cannot recognize clinically.

It is of more importance that degenerative processes in the optic nerve can also occur latently (without ophthalmoscopic signs). It is probable that sometimes, according to their situation and extension, they cause disturbances of the visual functions. Furthermore, it is remarkable that an ascendant degeneration generally is not produced by a very marked retinitis albuminurica of even long duration. They are ophthalmoscopically mild forms with a high-grade arteriolosclerosis of small retinal vessels which lead to severe disturbances at the inner layer with consequent injury to the nerve fibers.

Moreover, it may be regarded as certain that in the optic nerve and in the chiasma processes may occur which are not dependent on retinitis albuminurica. Retinitis and processes of the peripheral pathway may occur concurrently, as was evident especially in a long-observed case of retinitis with bitemporal hemianopic scotoma.

It seems that such independent diseases of the peripheral pathways can occur with various clinical aspects, such as circulatory disturbances and glaucomalike cupping, and moreover in the form of a rapid decrease of the vision combined with optic-nerve atrophy. For these several possibilities observations have been presented, most of which could be studied clinically and anatomically. It is deplorable that the manner of their development is often still undiscovered. It is quite possible that the changes of the small vessels are of great importance, and some of our observations can be interpreted in this sense; but an absolute proof in this direction has not heretofore been obtained. It is to be hoped that further systematic researches and favorable cases may lead to a clearer comprehension of the factors involved in the production of the observed clinical and histologic findings.

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SUBJECTIVE "LIGHTNING FLASHES"

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The following short note is a description and analysis of a symptom-complex of which I previously published some cases in 1935 (British Journal of Ophthalmology, 1935, v. 19, p. 545) and which so far as I know had not previously been recognized. In the present group of 33 cases I have extended the observations of some of the previous ones and have added some new cases.

The phenomenon is not of very common occurrence but is not rare and comes within everyone's experience. It is a symptom which at times causes apprehension to the patient and, fearing lest it conveyed some serious implication, it formerly induced me to make a more meticulous examination than I now think essential.

The symptom consists of the occurrence of flashes of light, most often likened by the patient to lightning; they are usually vertical in direction and referred to the temporal side and are accompanied by the simultaneous development of opacities in the vitreous. They are more common in women, for among the present 33 cases 26 were in women, and this disproportion would seem sufficiently great to indicate a real sex difference. They seldom occur before middle age, for of the present group three patients only were under the age of 50 years, the average being just over 60. It may be accepted that the eyes are equally affected for in 11 the symptom occurred in the right eye, in 17 in the left, and in 2 both eyes were involved.

The chief importance of the symptom lies in its recognition and the realization that it is not of serious import, nor is it the forerunner of some more serious development. I feared at first lest it might be an indication of vascular disease, retinal detachment, an early neoplasm, or some other malady in the incipient stage.

I feel that a critical examination of the present cases, some of which have been watched for a number of years, justifies the statement that it is a symptom-complex that does not carry any serious implication either at the time or for the future: it is not a manifestation of migraine.

The 10 following descriptions may be taken as being typical of the subjective symptoms (see table for other details).

Case 7. Four days ago noticed flashes of light to outer corner of the left eye, was reading at the time; have gradually tailed off till now they are little bother. Six years later had not recurred.

Case 9. A month ago whilst in a cold east wind had sudden pain in the left eye and afterwards flashes of light at the outer side of it like lightning; not seen now. Could always produce them by looking sharply to the left in a dark room.

Case 11. Sees a flash of lightning in the left eye, quite momentary; it seems to follow the curve of the upper lid. Two years later they had gone.

Case 15. Vertical sparks before the left eye to the outer side, like fireflies or lightning.

Case 19. Last night for the first time just as she turned off the light on getting into bed saw flashes like lightning to the outer side of the right eye. It was quite a striking phenomenon and as quick as lightning.

Case 20. Twelve days ago a regular show of fireworks; at first thought they were fireflies (lived in India at one time)

and used to grab at them. Began at dusk, always exactly in the same direction and the same slope as if in a line.

Case 26. Ten days ago got a fly into the left eye; next day saw lightning flashes and the day after black spots. The flashes were very confusing like daggers, never knew when they were coming on; to the outer side; now very much less. For two days they were alarming; now things seem blurry as if seen through a fog (Vitreous opacities).

Case 29. Streaks always double like lightning; sometimes will go on for several hours; sometimes to the outer side vertically, sometimes obliquely, sometimes horizontally. Now (10 days later) much less marked. Come on quite suddenly and are quite different from anything she has had before (suffers from migraine).

Case 31. Four months ago started to see flashes of light to the outer side of the right eye; flashes coming down just like vivid lightning; now becoming thinner. At first saw them in daylight, now they come on about 5:30 p.m. Last night only saw a single flash and didn't come right down as they used to. Seen them once or twice in the left eye, keep getting a little better.

Case 32. One month flashes of lightning to extreme outer side of the left eye; perhaps 20 times a day; so quick can't say whether they are vertical. Gets in the way of looking to the left to see if anything is there. Also sees a sort of quivering to the outer side of the left, independently of the lightning.

Case 34. Flashes of light to the temporal side of the right eye. Spots before the right eye only.

It will be seen that the flashes are most often compared to lightning, in some cases, however, they have been likened to the flash of a flashlamp, to fireflies, to meteors, the flash of the headlight of a car. They are of momentary duration, usually vertical in direction, but occasionally have been described as being oblique, or curved, or horizontal. With few exceptions they have been referred to the temporal field, never to the nasal side.

As would be expected they are more conspicuous in the dark. They gradually and rather quickly become fainter and disappear, usually in a few weeks; in one case, however, they lasted as long as six months, and in one case they recurred three years later.

That there is an association between the appearance of the streaks and the contemporaneous development of a crop of vitreous opacities (or a fresh crop, if these were previously present) I have no doubt; although the presence of visible opacities in the vitreous in folk past middle life is so frequent that it is difficult to substantiate this statement. If observers will have the association in mind, they will readily satisfy themselves of the reality of the connection.

In a group of middle-aged or oldish patients, the presence of lenticular opacities, vascular disease, or glaucoma is likely to be found. But the occurrence of such in this group is not of unusual frequency, and in any case were this symptom a danger signal of some such serious lesion, it should prove to be of some specific lesion and not the oddments and defects which occur here.

I have investigated the refraction and visual acuity in every case and have assured myself that they have no bearing on the problem and further, what clearly is of great significance, the visual fields have been examined in all but a few cases and in no instance was there found any defect which was not to be accounted for by some extraneous lesion.

With regard to the immediate cause of the symptoms I have no knowledge. In my previous communication I suggested the possibility of their being due to the slow increase in size and ultimate rup-

TABLE 1

DATA RELATIVE TO CASES OF SUBJECTIVE "LIGHTNING FLASHES"

Name	Sex	Age	Period Under Observation	Field of Vision	Description of Flashes	Other Observations
1. Lambe	F.		1 day	Complete	Lightning flashes outer side O.S.	
2. Wolff	F.	50	1 day	Complete	Whirling flashes of light to temporal side; seen with eyes shut	
3. Hatt Cook	F.	67	6 yrs.	Lt. defect due to choroiditis	Lightning to outer side O.D.	Seen rarely in the O.S.
4. Ledger	F.	50	8 yrs.	Small defect	Flashes of light O.D.	Field defect due to choroiditis
5. Turner	F.	60	3 yrs.	Complete	Flashes of light like a crescent, concave upwards	Three years later no recurrence
6. Vlasto	F.	35	*11 yrs. 4 yrs.		Vertical flashes	Four years later no recurrence
7. Burton	F.	60	*12 yrs. 6 yrs.	Complete	4 days ago noticed flashes of light at outer corner of O.S.; was reading at the time; they have gradually tailed out till now are little bother	Six years later does not now see the flashes
8. Roberts	F.	78	1 day		Sparks seem to come out of the outer corner of O.S.	
9. Forster	F.	68	1 mo.	Complete	A month ago, suddenly, whilst in a cold East wind pain in O.S. followed by flashes of light at the outer side of it like lightning	The flashes are not seen now, could always produce them by looking sharply to the left in a dark room
10. Gratian	F.	52	8 yrs.		Streaks of light to outer side of O.S. after a blow	8 years later still sees them just like a flick but very slight, like red lightning
11. Charles	M.	80	4 yrs.	Complete	Sees a flash of lightning in O.S., quite momentary; it seems to follow the curve of the upper lid	Quite gone 2 years later
12. White	F.		1 day	Complete	Flashes of light like lightning to the outer side of O.D. several times a day	Old iritis in left eye
13. Cohen	F.		1 day	Constriction of nasal side	4 days flickering of light through outer side of O.D., particularly when it is dark when eye is opened	Less marked the last day or two
14. Christie	F.		1¼ yrs.		A few weeks lightning flashes O.S., they strike horizontally outwards	Thrombosis of Lt. upper temporal vein
15. Nicholson	M.	66	1 day	Complete	Vertical sparks before O.S. to the outer side like fireflies or lightning	

TABLE 1 (*Continued*

Name	Sex	Age	Period Under Observation	Field of Vision	Description of Flashes	Other Observations
16. R.L.O.H.	F.	68	1 day		Streaks like silver lightning for one week, O.S.	
17. Renwick	F.		1 day		Flashes of lightning lasted one day to the outer side of O.S., and now a sort of flicker there	
18. Addington	M.	65	1 day		Flicker of light curved like meteor on going from the light into the dark	
19. George	F.	67	1 day	Complete	Last night for the first time just as she turned off the light saw flashes of lightning to the outer side of O.D. It was quite a striking phenomenon and as quick as lightning	
20. Barker	M.	69	*4 yrs. 3 yrs.	Complete	12 days ago a regular show of fireworks; at first thought they were fireflies and used to grab at them (lived in India at one time). Begin at dusk, always the same direction and same slope; always exactly as if in a line. One night had a regular fireworks show	
21. Watson	F.	56	1 day	Complete	Very bright, like sparks at outer side of the eyes when in the dark	
22. May	M.	52	*14 yrs. 3 yrs.	Complete	4 days ago whilst playing cards quite suddenly on looking to the left, saw what was like a shooting star, always to the left. When got home going up stairs noticed a light like the reflection of a headlight coming towards him. Still sees this in the dark, but less than formerly; last night the headlight effect was very faint	
23. Nathen	F.	64	10 yrs.	Complete	3 weeks ago, suddenly saw flashes of light to the right of O.D.	
24. Longworth	F.	49	*15 yrs. 12 yrs.	Complete	3 weeks ago saw flashes to the outer side of O.S. and only in the dark. They do not interfere with reading because they are at the side	
25. Morris	F.	58	1 day	Complete	One year ago saw slits and light to the outer side of O.S.	
26. Baker	F.	70	1 day	Complete	10 days ago got a fly into O.S.; next day saw lightning flashes and next day black spots. The flashes were very confusing like daggers; al-	

TABLE 1 (*Continued*)

Name	Sex	Age	Period Under Observation	Field of Vision	Description of Flashes	Other Observations
					ways to outer side, now very much less. For two days they were alarming; now things look blurry as if in a fog (due to the vitreous opacities?)	
27. Benham	M.	61	*6 yrs. 5 yrs.	Complete	Lights like lightning to outer side O.D. Since then a black spot has been more marked. Lightning now gone off	Symptoms recurred 3 years later
28. Nettleton	F.		1 day		3 weeks ago flash of light vertically to outer side of O.D., followed by fresh spots before the eye although she has always seen muscae. Now almost entirely gone. Flashes afterwards appeared before O.S., curved like an arc to lower outer side. Black spots in O.S. have not increased since flashes appeared	
29. Madge	F.	42	*15 yrs. 5 yrs.	Complete	Streaks, always double like lightning, sometimes will go on for several hours, quite quick like lightning; sometimes to outer side vertically, or obliquely, or horizontally. 10 days later much less. Quite different from anything she has seen before. Came on quite suddenly	Migraine many years before. O.S. old perforating injury. Streaks do not affect her sight
30. A.N.O.	F.	57	1 day	Complete	Flashes of light to outer side O.D., quite like lightning	
31. Bradford	F.	64	1 day	Complete	4 months ago began to see flashes of light to the outer side of O.D. coming down like vivid lightning; now becoming thinner. At first saw them in daylight now chiefly come on about 5.30 p.m. Last night saw only a single flash and didn't come right down as they used to. Thinks no day in the last six months when she hasn't seen them. Keep getting a little better	Has a high blood pressure and marked retinal evidence of vascular disease but neither hemorrhages nor exudates. Seen them once or twice in the O.S.
32. Kickwood	F.		1 day	Complete	One month flashes of lightning to extreme outer side of O.S.; 20 times a day, so quick can't say whether they are vertical. Gets in the way of looking to the left to see if anything is there	Sees a sort of quivering to the outer side of this eye quite independent of the lightning
33. Hinds	F.	61	*14 yrs. 1 yr.	Complete	Flashes of light to outer side O.D.	

* The first figure indicates the total length of time the patient was under observation, the second figure the period after the first appearance of the "lightning flashes."

ture of a small peripheral retinal cyst, pointing out at the same time that this did not offer any explanation of the sex incidence nor of the site of the flashes. I have no substantial evidence to offer in favor of this idea; it is, indeed, no more than a guess, but it seems to me to be a reasonable and rather likely explanation.

SUMMARY

A symptom-complex is described which consists in the appearance of flashes of light, most frequently likened to lightning, seen to the temporal side of the eye, never to the nasal side, and vertical in direction.

These flashes are accompanied by the simultaneous development of a crop of opacities in the vitreous. They seldom occur before middle age and are more frequent in the female sex. They do not imply any serious disease of the eye either at the time or subsequently.

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SELECTION OF THE TEST OBJECT IN PERIMETRY

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In the practice of ophthalmology there is probably no greater variation in the methods used by different examiners than in the taking of the visual fields. This is especially noticeable in the selection of the test object when there is a marked loss of visual acuity.

Comparing briefly the methods of two ophthalmologists who are recognized authorities on perimetry, it is noted that Peter[1] advises the taking of both the peripheral form field and the color fields on the perimeter and expresses the belief that too small a test object will lead to uncertainty and error. For the detection of early changes in the field, Traquair[2] advocates the examination of the central form field with a 1-mm. test object at a distance of 2,000 mm., or at even 3,000 or 4,000 mm. He considers the peripheral field as being of less importance, and that "little, if anything, is to be gained by routine color testing."

In an examination by either the qualitative or the quantitative method, the field will vary with the size of the stimulus. When the field of a normal eye is examined by the quantitative method, the size of the field is reduced with every reduction in the size of the test object, each isopter being a normal field for the stimulus used and its distance from the eye. If, for any reason, such as an error of refraction of a high degree, the eye cannot see the test object clearly, the effect on the field is similar to that of a reduction in the size of the object, and the field is correspondingly reduced. Because of these variations, and since different examiners may select test objects of different sizes, the findings of field examinations do not have the same uniformity that, for example, findings of visual acuity have.

In the study of the changes produced by using test objects of different sizes, I have made field examinations of patients who had greatly reduced vision and an error of refraction of a high degree, but who had normal fundi and normal visual acuity with correction. It was found in these examinations that when the fields were taken with a test object of the size usually recommended there was a concentric contraction with respect to the normal isopter for that stimulus; but when they were retaken with a test object that could be distinctly seen, normal fields for the stimulus used were obtained. The average contraction on the perimeter with the smaller test object was from 10 to 15

degrees. Evidently this contraction was due to the inability of the patient to see the test object, and not to a pathological condition.

From the results of these examinations, it may be assumed that if an eye had a loss of vision due to an error of refraction of a degree similar to that of the eyes examined in this study and a pathological condition was also present that further reduced the vision, the field obtained with the smaller test object would show the contraction due to the pathology and also the contraction due to the loss of vision from the error of refraction. This field, therefore, would not correctly reflect the condition of the eye, because a greater reduction from normal would be shown than would be produced by the pathology alone. There would also be, as Peter[1] suggests, the possibility of error due to uncertainty when the smaller test object was used.

In charting the peripheral field of an eye that has a loss of central vision, greater accuracy is obtained by using a stimulus that is distinctly seen at the distance at which the examination is made. For uniformity, it should also be a stimulus of the smallest size that can be so seen. If these two conditions are fulfilled, the field examination is in no sense a visual test, and all fields are taken with test objects having a similar relation to the clearness of vision. Any method of selecting the stimulus that will, if only partially, meet these conditions should at least aid in obtaining full and uniform peripheral fields without any modification that might be caused by a loss of vision that is not due to a pathological condition.

To recapitulate: For accuracy and uniformity, all peripheral fields should be taken with a stimulus of the minimum size that will give distinct central vision, thus placing all eyes examined on an equality, notwithstanding their varying degrees of nonpathological loss of central vision. To meet these requirements as nearly as possible, the test object is selected in the following manner: A set of white trial test objects, corresponding in size to the regular test objects, was obtained.* In the first experiments, three different trial shapes were used: round, square, and hexagonal. The hexagonal shape did not prove to be of practical value, so it was discarded. Each side of the square trial stimulus was made slightly shorter than the diameter of the round trial stimulus, making the area of the two approximately the same. The size to be used in taking the field is determined as follows: With the patient's head in position on the chin rest of the perimeter and one eye covered, these trial test objects are placed on the arm of the perimeter in pairs, a round and a square one of the same size, in the line of central vision of the eye that is being examined. Beginning with the 1-mm. objects, their size is increased, if necessary, until the patient can recognize the shape of each. The pair of smallest test objects that can be so recognized, accurately and readily, determines the size of the stimulus to be used for that eye. Selection of the test object in this manner is done so quickly that the time element need not be considered.

By selecting the test object in this manner, no eye is handicapped by a loss of central visual acuity that does not have a pathological background. I have found this method to be an aid in obtaining greater uniformity and greater accuracy in the findings of peripheral-field examinations.

520 West Seventh Street.

* These trial test objects were made by the Superior Optical Company of Los Angeles.

References

[1] Peter, L. C. Principles and practice of perimetry. Philadelphia, Lea & Febiger, 1938.
[2] Traquair, H. M. Arch. of Ophth., 1939, v. 22, Dec., no. 6.

NOTES, CASES, INSTRUMENTS

ARRANGEMENT OF INSTRUMENTS FOR OPHTHALMIC OPERATIONS

INSTRUMENT "SET-UP" MANUAL

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When the ophthalmologist has occasion to operate at a general hospital, he is apt

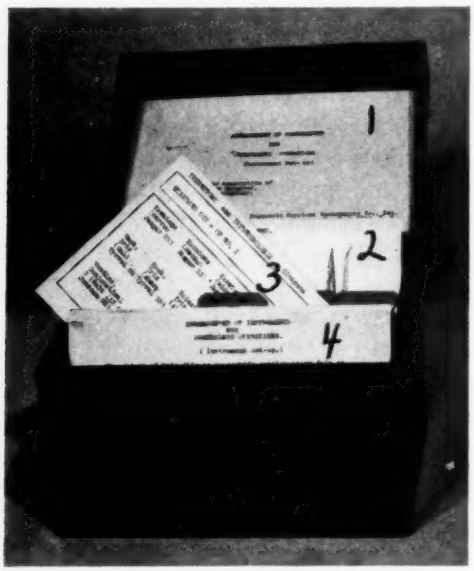

Fig. 1 (Evans). No. 1. Title and introduction card; No. 2, one of the cards showing detailed picture of instrument; No. 3, card tabulating instruments as arranged on table; No. 4, supplementary data and directions for use of systems.

to find that the operating-room nurses are unfamiliar with the ophthalmic instruments. Even in certain general hospitals maintaining a department of ophthalmology, it is not always possible to provide an "eye-trained" nurse to assist in the operating room.

It even happens, on occasion, that an ophthalmic surgeon must operate without the help of an assistant ophthalmologist. He may have no one who can arrange the instrument table and accessories or one who can be ready to present the necessary instrument as needed during the course of the procedure.

It is obvious that such a situation might arise when emergency hospital units are created; as for example, by the Red Cross, Army, or Navy.

In 1936-37, during the reorganization of a department of ophthalmology at one of our hospitals, it was found advisable to provide a manual of technique and procedure for the guidance of the nursing and resident staffs. During the writing of this work, the necessity for an operating-room instrument "set-up" plan was recognized.

The basic plan was to provide a card system, showing by means of pictures and description, each instrument used in ophthalmic surgery, properly named and marked so that it could be recognized by the novice and accompanied by a plan for "setting-up" the instrument tables for each operation; the instrument cabinet being appropriately arranged for the filing by number of each instrument.

Special effort was made to allow for modifications so that each operator could adjust the arrangement to meet his preferences or special requirements. It is recognized that no single plan can be universally acceptable. The presented set of cards should, however, serve as a basis from which any ophthalmologist can evolve his own arrangement.

The presented system is sufficiently comprehensive to permit preparation for the usual more frequently performed ocular operative procedures.

The first five cards of the file are introductory and describe the method of using the system. A diagram is next shown, which portrays various arrangements of

operating-room table and furniture with positions of operator and assistants indicated. Thirty-four cards are included on which the names of instruments appear in position as they are to be arranged on the instrument table. A series of 111 photographs follows these cards, which illustrate instruments used in the "set-up" plans.

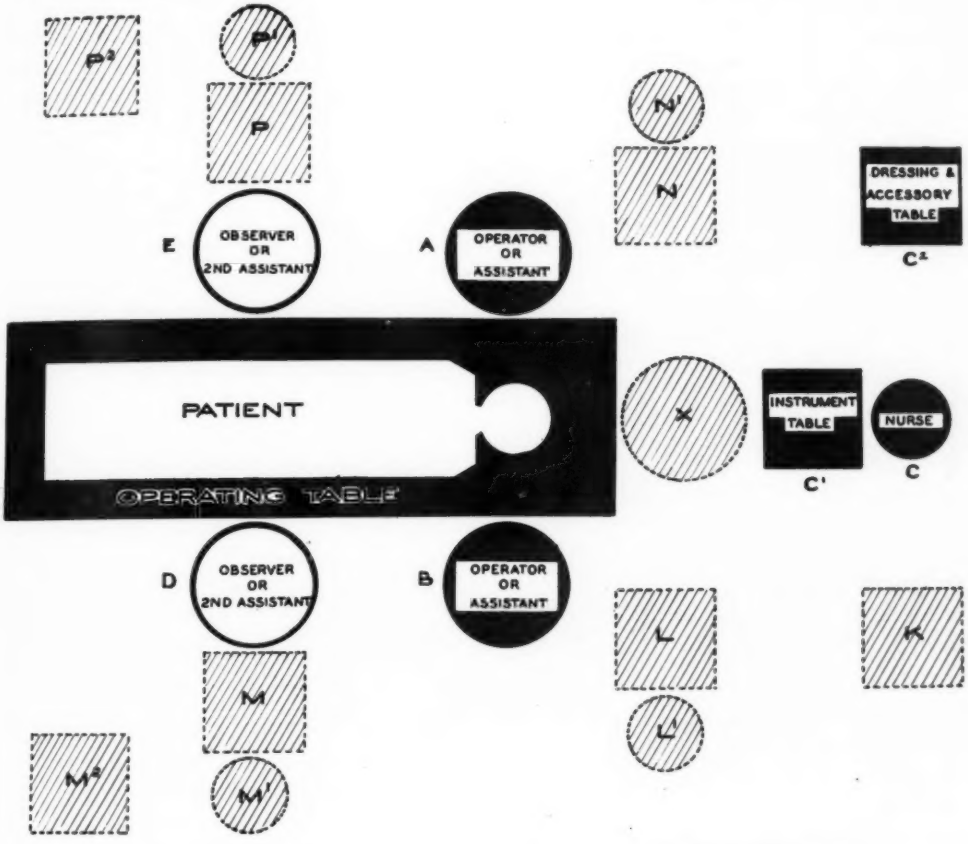

Fig. 2 (Evans). Arrangements of tables and attendants in operating room.

The introductory cards contain the following description: ARRANGEMENT OF INSTRUMENTS FOR OPHTHALMIC OPERATIONS

The object of this file is to provide supplementary data on instrument set-up for each of the standard eye operations. It may be modified to accommodate the habits of each operator. It is particularly designed for general hospitals which have an eye department and in which it is the custom to use general surgical nurses, either occasionally or usually, as ophthalmic nurses. When these conditions obtain inconveniences and annoyances arise, as the nurses are less familiar with the names and uses of the various special instruments.

The following is the arrangement of the typed cards, nos. 1 to 35. The title across the top corresponds to the name of the operation as it is likely to appear on the operating-record sheet. A modification or the name of a condition for which the operation is performed appears in brackets adjacent to this.

The material on each card is so arranged as to correspond to the position of the named article on the tables. In preparation for the operation, the nurse should place the card before her with the title up. The top of the card will then represent the part of the table nearest the instrument nurse (as it will be during the operation), and the bottom of the card will represent the edge of the table nearest the assistants and are to be placed on the instrument table C^1 nearest the nurse and remote from the operator. The instruments are arranged from left to right in the order to be used.

The remainder of the card contains those major instruments most likely to be used by the operator himself, in sequence from the upper left in a horizontal row across the table. When the last instrument

CORNEO- SCLERECTOMY (LAGRANGE) - Glaucoma I

STANDARD SET - UP NO. I

Mouse-tooth Forceps - 2 (Iris 15 or Lester 32)	Keratome (narrow Jaeger 33)	Keratome (medium Jaeger 33)	Keratome (wide Jaeger 33)	Punch, Scleral (Holth 18)	Scissors, Iris (curved 23)
Scissors, Iris (deWecker 27)	Scissors, Iris (Stevens 30)	Mouse-tooth Forceps 2 (Iris 15 or Lester 32)	Spatula (Knapp 57)	Dressing Forceps (straight serrated 7)	
Needle Holder (Berens 34 or Stevens 71)		Needles, Conjunctival 3 (Kalt 113 or Jameson 72)	Sutures (000 gut- 10 day chromic #1 braided silk)		

Fig. 3 (Evans). Card 3 (of figure 1), showing author's "table 1," which the nurse uses as a guide for placing instruments on the table.

surgeon or his first assistant (as it will be when the operation is under way). Each article being arranged in order, the nurse or the operator can pick up the succeeding instrument as required, and it is returned to that particular spot on the table when not in use.

The panel nearest the top of the card represents the dressing and accessory table C^2 (fig. 2) as indicated on card 1.

The next panel on the card represents the standard set-up, which is alike for all intraocular operations. These are the minor articles likely to be used by as-

in the first row is reached, the next instrument in order will be in the second row at the left-hand edge. Succeeding rows are arranged horizontally in this manner. The nurse can thus be sure that each instrument is washed or warmed as needed, and can replace it in its proper position when released by the operator.

Standard Set-Up No. (fig. 3, card so marked) is made up first and the additions for the special operation are appended. This makes it easier for the nurse gradually to become familiar with the instruments. No effort is made, of course,

to provide every instrument that every operator might elect to use. The back of these cards is reserved for notes as to the special habits and preferences of the various surgeons. The hypodermic-needles-anesthetic marked with an * represents a flexible designation which will vary so much with each operation—on account of the preference of the operator—that it will be necessary to refer to special directions for equipment for the various types of local anesthesia.

No effort is made to specify necessary drapes, draping clamps, provisions for gowns, or lighting arrangements; for these factors are usually modified by general orders which govern the department. Personal desires of each operator can, or should be specified in writing on the back of the set-up cards. Standing modifications of general technique or management should be appended to these instructions.

The classical arrangement of the scrub nurse, instrument table, operator, and assistant are shown at A, B, C and C^1 with the observers or second assistant at D and E. C^2 is the dressing and accessory table containing objects of minor importance. When the nurse and instrument table are shifted to L and L^1, C^2 may be shifted to K. It can be left in the original position, however, when the nurse and instrument table are shifted to N and N^1. The shifting is necessitated by the operator's preference to stand at the head of the table. Some operators prefer their assistant to stand opposite to them as A to B, or B to A, and sometimes prefer the scrub nurse and her tables in the positions of P, P^1 and P^2, M, M^1 and M^2. Other arrangements are occasionally desirable; and if an operator employs them frequently, a separate diagram should be added to this card system.

It is obvious that it might facilitate the selection of instruments to have the name of each instrument numbered on the filing cards corresponding with the numbers of the illustrations. The nurse could then select the instruments from her cabinet by number instead of by name (the instruments and positions in cabinet might also be numbered correspondingly). This is to be avoided because the main object of the card system is to teach the nurses and the assistants to identify the instruments. Hence, the nurse should select the instruments by name and by consulting the corresponding illustration.

The catalogue of the firm of E. B. Meyrowitz was used as a source of illustration in developing this manual.

23 Schermerhorn Street.

FLUORESCENT LIGHTING IN THE TAKING OF CENTRAL FIELDS

A. W. McAlester, 3d, M.D.
Kansas City, Missouri

For the past two-and-a-half years, we have been using fluorescent lamps in the taking of central fields. The light consists of two 20-watt fluorescent daylight bulbs, mounted in a dull-finished aluminum reflector. The mountings are stock fixtures that can be obtained from any chandelier manufacturer. When the lights are placed 130 cm. from the center of the screen at an angle of 45 degrees, the illumination varies from 10 to 12 foot-candles. This can be determined by a Weston "sight meter."

The value of this type of illumination is that it comes nearer to approximating daylight than does any other lamp and gives truer values to the red, green, blue, and yellow. In analyzing the spectrum in the three primary colors of light that we use in visual-field tests, we obtain the following chart:

20-watt daylight fluorescent lamp
Red—32% Green—44% Blue—24%

60-watt Mazda lamp
Red—52% Green—40% Blue—8%

Both units provide 10 foot-candles at 130 cm. This chart readily shows a more equal distribution of the color intensities when fluorescent lighting rather than the conventional Mazda lamp is used.

The center of the screen is 125 cm. from the floor. The screen is made of gray velveteen mounted on a piece of wall board. The scotomas are outlined on the screen by rubbing the end of the target against the grain of the velveteen, thus eliminating pins or chalk. The screen can easily be smoothed out with the palm of the hand. A small mark made on the screen cannot readily be seen by the patient, which eliminates any error on the patient's part in producing the same visual field on rechecking. This feature is also valuable in checking malingerers.

We have tried hanging the lights from the wall and also from the ceiling, but were dissatisfied with this, due to the fact that they could not be readily moved when we wanted to increase or decrease the amount of illumination. To increase the illumination, the lights are moved closer to the screen, and to decrease, away from the screen; this does away with rheostats.

When a patient has difficulty in reading under artificial lights, we use these lamps to ascertain whether it is the type of illumination that is causing the reading problem.

2003 Bryant Building.

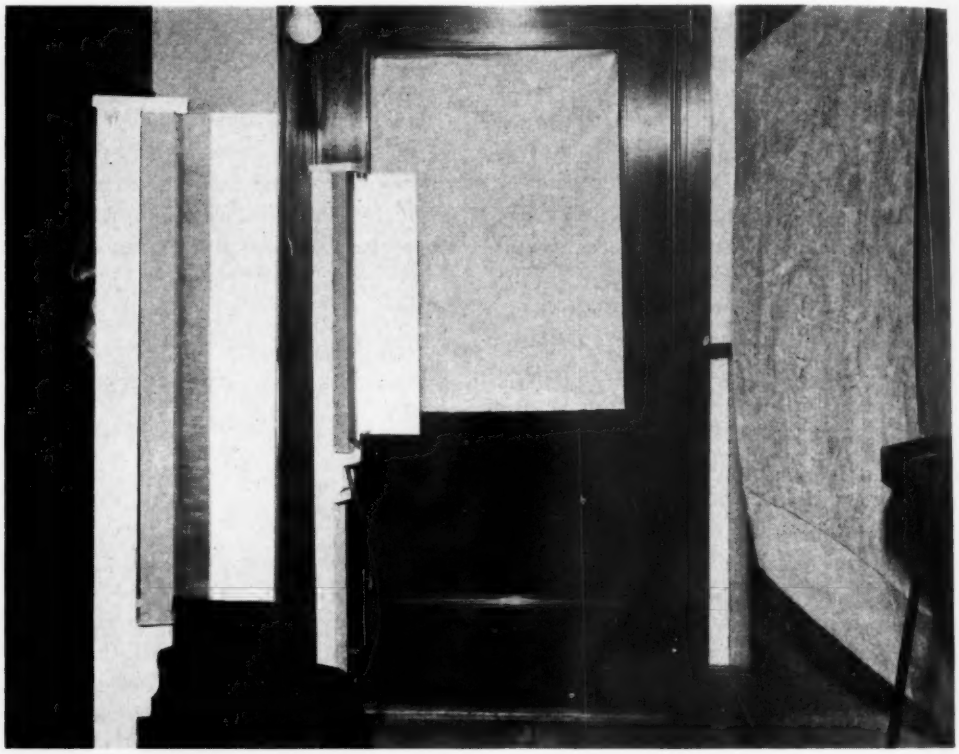

Fig. 1 (McAlester). Fluorescent illumination for central-field tests.

SOCIETY PROCEEDINGS

Edited by Dr. H. Rommel Hildreth

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

April 12, 1939

Dr. Percy Fridenberg, *presiding*

Ocular development in the 7-mm. embryonic stage

Dr. Abraham Kornzweig read a paper on this subject and showed slides in connection with it. He showed that the lower part of the optic vesicle develops later, though it is less retarded in the human eye than in other vertebrates. Also, all the numerous anomalies associated with retardation of development take place here rather than in the upper portion. This is a sign of specialization, for originally the vertebrate eye was adapted to four-footed animals and the upper part of the optic vesicles developed first so that they could look down for their food and protection. With the development of the two-legged animal upward gaze gradually became more important.

Binocular vision and its variations

Dr. Ralph I. Lloyd said that while prismatic aberration and size difference have always been recognized as factors in anisometropia, it was not until Henschen of Sweden gave us the results of his studies of the visual cortex that the details of the mental side of the act of combining two retinal images into one three-dimensional image became known. Henschen clearly showed that of the two layers making up the Gennarian stripe, the superficial one was made up of three strata of which the superficial and deep disappeared if both eyes were lost early in life. Henschen argued that this persistent central layer was the ultimate combining place of impressions received from the other two layers so there was double cortical representation as well as double retinal representation. If one of these layers is altered the combination of two unlike impressions into a single impression is altered. This suggests that if the difference in the images of the two eyes is marked there would be difficulty in getting them together. It follows that the most we can do for these cases is to make one macula work as nearly like its fellow as possible. In just the degree that we can do this, will there be success in effecting binocular vision. Refraction, orthoptics, and occlusion treatment are all important here, though there are limits to their efficiency.

Psychopathology of vision

Dr. Kurt Goldstein read a paper dealing with phenomena of vision observed in diseased states of the central nervous system, which can be explained only by a conception of vision as a function of the whole organism. This conception presupposes a sort of center of vision unifying all the factors that go to make up the visual complex. He showed how the central factor, or the need of the organism to recognize objects against their normal background, determines the direction and extension of the field of vision in various types of field defects. Such patients may adapt themselves to visual defects without voluntary effort and even without their knowledge.

He also discussed the influence of this central factor on visual acuity and demonstrated that the acuity of a part of an object depends upon the perception of the whole object. The moment you add lines which make a swastika out of a

cross the ends of the lines of the cross are more clearly seen.

Discussion. Dr. Charles A. Elsberg agreed with Dr. Goldstein on the importance of the central factor in vision. He contrasted the results obtained with perimetry and campimetry, stating that in the former, results are based on expectation of size and form while in the latter there was a lack of expectation for form. In investigations made by him and Dr. Spotnitz it was becoming increasingly apparent that the central factor in vision is of extreme importance and that the speed of visual processes depends basically upon the speed of the central process.

Dr. Morris Davidson told of a recent case of head injury in which the man's vision was 20/100, but when one letter at a time was exposed his vision was 20/20. The patient had no central nor peripheral field defect, apparently, but stated that he did not see what he was writing when asked to write his name. Dr. Davidson asked if this was a case of agnosia or amnesia.

Dr. LeGrand Hardy stated that in a study of the history of perimetry which he made dating from 3000 B.C. to 1931 A.D. he had never found any technique to rule out the optical factor. He said that he would like to see the emotions measured. We see what we are conditioned to see and the logic of our experience interprets it.

Dr. Joseph Pascal said that Dr. Verhoeff had shown by a special test that one can have stereoscopic vision when the difference in acuity is as great as 20/20 in one eye and 20/200 in the other.

Dr. Percy Fridenberg said that Dr. Lloyd's data would completely upset Helmholtz's theories. If there is a special layer in the cortex which combines visual impressions into a three-dimensional concept, then how explain the well-established fact that form and depth perception are acquired by experience under the control of tactile and haptic sense-impressions and the kinesthetic sense?

Dr. Kurt Goldstein, concluding, said that Dr. Davidson's case was an example of agnosia which is an inability to recognize shapes, while amnesia is a matter of memory. What he called the central factor was something to be expressed in behavior psychology and is related to anatomic-physiologic processes and has nothing to do with psychoanalysis. There is nothing mystic about it since normal visual acuity also changes constantly as to function of various retinal points. What is found in hemianopic patients is the normal way of adjustment.

Dr. Ralph I. Lloyd in further discussion and in response to questions said that the hyperopic eye is an underdeveloped eye which even with correction does not see as well as the myopic eye with correction, as a rule. A patient with 20/20 in one eye and 20/30 in the other will not have good depth perception. If the vision in the poorer eye is reduced to 20/40 an intermittent squint is present. Such a patient uses both eyes for coarse work but only the better for fine work. Dr. Lloyd stated that the brain can adjust to all sorts of conditions and that there was nothing in his theory which conflicted with Dr. Fridenberg's conception of the mental phase of vision.

Sidney A. Fox,
Secretary.

NEW YORK SOCIETY FOR CLINICAL OPHTHALMOLOGY

May 1, 1939

DR. PERCY FRIDENBERG, *president*

SIMPLE METHODS OF LENS CALCULATION

DR. JOSEPH I. PASCAL presented a paper on the above subject which was

published in the February, 1940, issue of this JOURNAL.

EPITHELIOMA OF THE PALPEBRAL CONJUNCTIVA

DR. MAX GOLDSCHMIDT pointed out that only eight cases of this rare condition are described in the international literature. He reported one case of a 26-year-old woman in which unsuccessful attempts to treat the condition with border rays had been made. Surgery was finally resorted to and no recurrence has been noted as yet.

CYST OF DESCEMET'S MEMBRANE

DR. MARK J. SCHOENBERG reported this case, which had developed following cataract extraction with recurrence of the cyst one year later.

Discussion. Dr. Ernst Waldstein stated that a cyst, whether of the iris or of the posterior cornea, was due, as a rule, to a cataract extraction performed without conjunctival flap. He thought that it might be a good idea in such cases as the one presented to make a large corneal section as for cataract extraction and to tear out part of the posterior wall of the cyst.

Dr. Sigmund A. Agatston reported a similar case treated as outlined by Dr. Waldstein in which the patient's eye had healed with only a small scar.

Dr. Percy Fridenberg thought that these cysts could be produced by any method which tended to injure Descemet's membrane even slightly and make it peel off.

Dr. Mark J. Schoenberg, in closing, said that he doubted whether such cases were the result of failure to make a conjunctival flap, otherwise there would be more than three cases reported. He thought it probable that there was some specific process starting from the ciliary body which extended into the cornea and formed the cyst.

OCULAR PULSATION

DR. ISADORE GIVNER presented two cases of ocular pulsation. The first was a patient with neurofibromatosis and congenital absence of the orbital roof. The other was a case of arteriovenous aneurysm of the internal carotid in the cavernous sinus.

Discussion. Dr. John Foster (England) said that about two years ago he saw four cases of neurofibromatosis within two months. One case was that of a boy who developed elephantiasis neuromatosa and a painful eye giving a disgusting appearance. There was no pulsation and X-ray plates showed thickening of the orbital roof. The orbit was exenterated. On section the eye proved to have neurofibromatosis of the choroid. There was a tremendous amount of hemorrhage requiring repacking. The boy died of meningitis four days later and autopsy showed the inner wall of the orbit to be missing.

NODULAR IRITIS IN A PATIENT WITH LEBER'S DISEASE

DR. ADOLPH POSNER presented a 35-year-old woman who had been under observation for 15 years for Leber's disease. During this time she developed opacities of the posterior lens cortex of the right eye, and the iris became studded with minute reddish nodules situated superficially in the iris and vascularized by newly formed capillaries. There was no iritis nor were there any other subjective signs. The left eye was entirely normal. Two brothers also having Leber's disease showed no iritic manifestations.

OCULAR TUBERCULOSIS IN FISH

DR. ERNST METZGER stated that ocular manifestations in fish are strikingly similar to those seen clinically in man.

VITAMIN-D COMPLEX IN MYOPIA

DR. ARTHUR A. KNAPP read a paper

on this subject which was published in this Journal (December, 1939).

Discussion. Dr. Arthur M. Yudkin said that all ophthalmologists would welcome a way of getting rid of myopia. It is very interesting to note how many things the vitamins are said to cure and yet the specific vitamin which would cure any one disease has yet to be found. It is not fair from what has been presented in this paper to conclude that vitamin-D complex is a cure or corrective for myopia.

Dr. Mark Schoenberg wondered whether cases showing an improvement of one fourth of a diopter should be included, considering that with our present methods of examination it is not always possible to recognize so small a change in a myopia of high degree.

Dr. Percy Fridenberg said that it was not easy to understand how the well-known tissue changes and alterations in ocular proportions of myopia could be reversed. If myopia is scleral rickets and due merely to lack of calcium and/or vitamin D we should expect a large incidence of myopia in systemic conditions such as fragilitas ossium with blue sclerae where the sclera is really almost calcium free. If Dr. Knapp had taken 100 cases of rachitic children and shown that they had myopia more generally than healthy children, and if his cases had been grouped according to age or degree of myopia, the data presented would have had a meaning.

Dr. Knapp in summarizing said that myopia was not a single-vitamin-deficiency state and that he did not believe that he had found the cure for myopia. Nor was myopia scleral rickets but it is a part of a general condition as pointed out by Dr. Fridenberg. There is no definite evidence of a calcium deficiency in blue sclerotics; there are theories but nothing tangible.

Topographic chart for reporting eye injuries

Dr. Morris Davidson presented a proposed new chart for the graphic representation of eye injuries.

Technique of pictorial representation of eye conditions

Dr. Percy Fridenberg said that pictorial representation by the physician himself was useful not only for the record, but was a valuable factor in training close observation and manual dexterity. He described various media for reproducing eyes in color as well as the making of the rough drawing.

Sidney A. Fox,
Secretary.

COLLEGE OF PHYSICIANS OF PHILADELPHIA

Section on ophthalmology

October 26, 1939

Dr. Alexander G. Fewell, *chairman*

Rhinosporidiosis of the conjunctiva

Dr. Harold J. Barnshaw and Dr. William T. Read, Jr. said that the growth was of the upper right lid. The patient a young man, aged 17 years, was born in Philadelphia, and had always lived in this vicinity. He had never lived on a farm and had never traveled any distance. The growth was removed with no recurrence.

Discussion. Dr. William T. Read, Jr., said the pathology of rhinosporidiosis is one of chronic inflammation with the organisms seen in the inflammatory tissue. The picture in this case resembles all those previously reported. In their section, the smallest organism measured 20 microns; the largest, 250 microns. The latter contained numerous spores and well-developed cellulose wall beneath the chi-

tinoid envelope. One was extremely near the surface epithelium and suggests that discharge of the spores might be on the conjunctival surface. The large organism with spores is called a sporangium. The entire lesion measured two to three millimeters in diameter.

DIPLOPIA FOLLOWING FRACTURE OF THE MALAR BONE (2 CASES)

DR. H. MAXWELL LANGDON AND DR. ROBERT H. IVY said that diplopia has been frequently observed following fracture of the malar or zygomatic bone involving the floor of the orbit. In 11 cases Dr. Ivy has noticed diplopia in four. In only two of these cases was a detailed study made of the diplopia. In both, Dr. Langdon found that it was due to a paresis of the inferior oblique muscle.

Case 1. W. S., aged 17 years, was seen on April 10, 1934. He had been struck in the left cheek by a baseball two hours before. There was ecchymosis of the tissues of the left side of the face with some conjunctival hemorrhage. The globe was uninjured. The following day the swelling had subsided under ice compresses and there was found to be a definite diplopia upon looking upward—typical of a weakness of the inferior oblique muscle. A fracture of the floor of the orbit involving the malar bone was diagnosed. The following day the depressed bone was elevated by Dr. Ivy and the diplopia disappeared permanently and has not been present since. Central vision was never disturbed and the eyes are in other ways perfectly healthy.

Case 2. Miss C. C., aged 25 years, fell on December 21, 1938, striking the right maxillary region on the stone edging of a driveway. There was much contusion of the tissues, swelling of the lids, and subconjunctival hemorrhage. Central vision was not disturbed; the eyeball was healthy, but on looking upwards there was double vision typical of a weakness of the right inferior oblique muscle. X-ray study showed a fracture through the outer portion of the lower rim of the orbit. Dr. Ivy saw the patient on December 25th and operated on December 30th. The next day the diplopia was very slight and in a week had disappeared, since which time it has not returned.

The remarkable feature of the diplopia in these cases was that it cleared up almost immediately after the fracture had been reduced. The mechanism of the disability and of the rapid recovery is difficult to explain. The diplopia could hardly be due to actual trauma to the muscle or to infiltration with blood or serum, because in that case at least several days would be required for recovery. If due to third-nerve injury, recovery would be delayed still longer. If we look at the anatomical relations we note that the inferior oblique muscle arises from the anterior-inferior angle of the orbit, and has no other bony attachments, but passes outward and backward in the floor of the orbit to be inserted on the outer surface of the eyeball. Its bony attachment is a considerable distance medial to the usual fracture line, so that the paralysis cannot be explained by tearing of muscle fibers at the point of origin.

In the literature the nearest approach to this subject was found in a recent article by Novick, who has reported two cases of paralysis of the inferior oblique muscle following the Caldwell-Luc operation on the maxillary sinus. He stated that paralysis or paresis of this muscle is exceedingly rare and that few ophthalmologists or otolaryngologists have observed a case of isolated paralysis of this muscle. In his cases, Novick attributed the paralysis to injury of the muscle by penetration of the thin orbital wall of the antrum into the region of the origin of the muscle by the curette.

In our cases this explanation does not apply because there could hardly have been any tearing of the muscle fibers by the injury; nor would there have been such prompt recovery from the diplopia after reduction of the fracture. The only explanation we can offer for this temporary diplopia is a sagging or loss of tension of the inferior oblique muscle, which was instantly relieved by reduction of the fracture.

All of our recent cases of malar fracture with displacement have been corrected by the method described by Gillies, which consists in the use of a long elevator introduced through a small skin incision above the hair line beneath the temporal fascia and zygoma. By this means the depressed bone can be readily elevated into position even two or three weeks after the injury and the operation leaves no visible scar.

Discussion. Dr. Robert H. Ivy in conclusion said that he saw the patient mentioned by Dr. Carpenter this morning. He did not examine the eyes nor make a test for diplopia; but the patient said the double vision had disappeared. The most important point about these cases is the necessity of early replacement of the depressed fragment in order to avoid permanent disfigurement. After three or four weeks the bone may become firmly fixed and elevation is often impossible, whereas replacement is usually simple if done in the first two weeks.

Management of some cataract surgery complications

Dr. Edmund B. Spaeth presented a paper on this subject which will be published in this Journal.

Discussion. Dr. Francis Heed Adler said that the most annoying complication which he encountered was incarceration or prolapse of the iris. It did not seem to make much difference whether one makes a complete iridectomy or a peripheral iridectomy, prolapses sometimes occur; when large, they prove difficult to handle.

Dr. Walter I. Lillie stated that anyone who does ocular surgery encounters the complications that have been discussed by Dr. Spaeth. The use of sutures in cataract surgery minimizes the chances of severe iris prolapse. The use of pressure bandage rather than a pad and a shield has, in his experience, lessened the occurrence of iris prolapse.

Dr. Alfred Cowan said that he has examined a great many eyes after cataracts have been operated on, and by a great many surgeons. He believes there is hardly any method in which there is not at times either iris prolapse or anterior synechia regardless of the method and procedures by the surgeon.

Dr. Leighton F. Appleman said that he has been wondering whether, after the patient's eyes have been bandaged and he has been returned to bed, he may not have a feeling of irritation which provokes squeezing of the orbicularis in such a way as to produce pressure upon the globe, causing the lips of the wound to open slightly and allow the iris to slip forward and become caught between the lips of the wound. With this in mind, he has been particularly careful to warn the patients beforehand to avoid doing this during the time of healing.

Dr. Carroll R. Mullen reported that, with knowledge of the experimental work which had been done to prevent prolapse of iris, he performed a series of simple intracapsular cataract extractions with the use of corneoscleral sutures. The suture made a transverse passage through the cornea and a return transverse passage through the scleral or episcleral tissue, so that a double "lock" would close the operative incision. This was performed at the Wills Hospital. Instillations of solutions of paredrine and homatro-

pine preceded by an hour the time of the operation in order that a wide dilatation of the pupil might be obtained. Intraocular tension was recorded previous to the use of this medication, immediately preceding the retrobulbar use of novocaine, and about two minutes after the latter injection. Care was taken to prevent prolapse before the patient left the operating room. A weak solution of eserine salicylate was instilled immediately following the operation in order to bring about more favorable contraction of the pupil. In his series of approximately 30 to 35 cataracts, he was dismayed by a 30 to 35 percent occurrence of iris prolapse. The late operations were just as prone to this complication as were those performed earlier in his experience. Needless to say he has abandoned the simple extraction.

Dr. Louis Lehrfeld said that many complications following cataract extraction may be prevented by careful study of the patient prior to operation. If the surgeon is aware of the fact that he has an uncoöperative patient, he must be prepared to select anesthesia which will enable him to keep that patient under complete control during the operation. It makes no difference whether the anesthesia be general, using ether, or rectal, using avertin, or local, using the combined benefits of novocaine and cocaine. He believes that complete anesthesia at the time of the operation will help considerably in preventing such complications as iris prolapse.

At the Wills Hospital, he gives routinely a retrobulbar injection of 2-percent novocaine, a subconjunctival injection of 1-percent cocaine in the superior rectus muscle, and another subconjunctival injection of cocaine at the point where the fixation forceps is applied to the eyeball. Local instillation of 4-percent cocaine, as generally used by all surgeons, is likewise a part of the procedure to obtain complete anesthesia.

The patient is thus under complete control, avoiding unnecessary and unexpected movements of the eyeball and making the cataract extraction possible without complications on the operating table. It also permits complete rest of the patient for several hours following the cataract extraction.

Corneoscleral sutures, as introduced by him at the Wills Hospital, have also served to prevent complications by permitting patients to get out of bed shortly or very soon after the operation. He has had a number of cases in which the patient was permitted to sit in the rocking chair immediately upon return from the operating room, and permitted to go to bed only to sleep at night. In one particular instance, a very stout woman, weighing approximately 300 pounds, was so treated without complications. Other instances can be cited among the very aged, who were treated in the same manner. Other patients are routinely permitted to get out of bed very early on the third, fourth, or fifth day, depending upon the individual circumstances. By this method the surgeon avoids the postoperative tympanites, backache, restlessness, and tampering with the dressings.

Complete anesthesia of the eye, plus corneoscleral sutures (or what he prefers to call corneoepiscleral sutures) are both instrumental in the prevention of postoperative complications.

Dr. William Zentmayer said that some reference has been made to the effect bandaging has on prolapse of the iris. He has not used a bandage after cataract operation for the last 15 or 20 years, using instead narrow strips of isinglass plaster over the closed lid, running from brow to cheek, the only protection being a mask. The roller bandage which is applied around the head is very objectionable. The disturbance of the bandage produced by movements of the head is trans-

mitted to the pad in front, and disturbs its position.

The only objection to the strips is that they cannot be made sterile, but he has never had infection from them. He does not know that his proportion of prolapses is any less than that of the average operator, but he believes that a bandage might be the cause in some of the cases.

Dr. Edmund B. Spaeth in conclusion said that there will be as many different decisions, opinions, and recommendations as there are ophthalmologists present. He cannot agree with some of those stated above. Sutures do prevent, in many instances, an iris prolapse, but iris prolapse does not occur until 24 or 48 hours after the operation. The effects of the anesthesia are gone, the aqueous is reforming, and anything that will interfere with the free passage of aqueous through the pupillary aperture from the posterior chamber into the anterior chamber will cause an iris prolapse. It is for this reason that, in preventing iris prolapse, a peripheral iridectomy, since it lies at the root of the iris, is actually more efficacious than is a complete iridectomy.

Clinical and experimental studies of interstitial keratitis

Dr. Joseph V. Klauder, Dr. Elmer R. Gross, and Dr. Harold F. Robertson discussed theories of the motivating factor in interstitial keratitis: that it is caused by (a) a direct invasion of the Spirochaeta pallida, (b) an allergic reaction, (c) a nutritional disturbance.

Pieces of cornea removed from patients with interstitial keratitis failed to show Spirochaeta pallida when examined by different methods. Rabbits were injected intraocularly with horse serum. The ocular response to second injections of horse serum was studied by slitlamp microscopy. There was no definite evidence of an allergic reaction. Pericorneal congestion and contraction of the pupil, however, occurred.

Cutaneous tests were performed on patients with interstitial keratitis, employing a piece of cornea of the same patient and also the cornea of a syphilitic fetus. These tests were negative.

It was not possible to produce interstitial keratitis in syphilitic rabbits by repeatedly traumatizing the cornea. The slitlamp picture of interstitial keratitis was produced in some normal and in some syphilitic rabbits by intracorneal injections of horse serum. This was attributed to trauma.

Studies were made of heat applied to the cornea in treatment of interstitial keratitis. This embraced: (a) the use of the thermophore (instrument used to heat the cornea), (b) the thermo-couple to measure the degree of heat penetration of the cornea of rabbits, (c) the thermal death point of Spirochaeta pallida in relation to the maximum temperature at which the cornea can safely be tested, (d) the clinical use of the thermophore in treatment of the involved as well as the uninvolved eye in patients with interstitial keratitis, and in treatment of interstitial keratitis in syphilitic rabbits.

From these studies it was shown that the cornea is a poor conductor of heat. When the temperature at 130°F. was applied to the anterior surface of the cornea, the maximum temperature of the posterior surface behind the thermophore was 111°F. The maximum temperature the cornea will tolerate with safety is 130°F. for one minute. The temperature required to kill Spirochaeta pallida was at least 120°F. for two minutes. It was therefore not possible, after employing the thermophore in treatment of interstitial keratitis, to conclude by deduction that Spirochaetae pallidae are not present in the cornea.

Absorption of neoarsphenamine by the cornea after instillation into the conjunc-

tival sac, and the penetration of the drug into the cornea after intravenous administration in rabbits were studied. No arsenic was present in the cornea after successive instillations of a 1:600 dilution of neoarsphenamine. Following six consecutive daily intravenous injections of neoarsphenamine, 30 mg. per kilo of body weight arsenic was present in each cornea in the amount of 0.04 mg.

The involved and uninvolved eye of patients with interstitial keratitis were treated with repeated instillations of 9 c.c. of 1:600 dilution of neoarsphenamine. This solution was maintained in the sac for 20 minutes. Such treatment did not influence the course of interstitial keratitis.

Warren S. Reese,
Clerk.

CHICAGO OPHTHALMOLOGICAL SOCIETY

October 16, 1939

Dr. Earle B. Fowler, *president*

Complete ophthalmoplegia (two cases)

Dr. Helen Holt said that both patients presented examples of the paralytic syndrome of the orbital-apex–sphenoidal-fissure syndrome as described by Dejeans (1927).

The first patient, a man aged 31 years, had involvement of the right second, third, fourth, fifth, sixth, seventh, and ninth cranial nerves. The ocular muscles had gradually and progressively become paralyzed during a period of months. Vision was impaired and the fields contracted until total blindness resulted in the right eye. For some time the neurologist in charge of the case considered it to be a postencephalitic process. An exploratory intracranial operation was performed. A meningioma beginning in the frontal fossa and extending posteriorly was found to be too extensive to remove. Following the operation the muscles of the left eye are becoming involved and there is a choked disc.

The second patient, a woman aged 35 years, suffered from a violent right-sided headache for one month, followed by progressive paralysis of the extra- and intraocular muscles with slight exophthalmos and pain under pressure. Both central and peripheral fields were normal. A similar train of symptoms occurred on the left side two years previously and resulted in total blindness of the left eye but recovery of muscular function. Pressure in the region of the sphenoidal fissure was considered the causative factor. X-ray studies of this region showed no abnormality; the spinal fluid was normal in all respects. An infectious process involving the covering of the bone in this region was thought possible. Two injections of typhoid bacilli produced violent reactions. A subtemporal intracranial exploration showed the dura surface to be unbroken but the tissue was swollen and spongy about the sphenoidal fissure. No tissue was removed. Recovery followed with return of function of all the ocular muscles with no impairment of vision, but with some vasomotor disturbances in the region of the ophthalmic branch of the fifth cranial nerve.

Both cases illustrate the effect of pressure at the apex of the orbit at the sphenoidal fissure, where the ophthalmic branch of the fifth, the third, fourth, and sixth sympathetic fibers and the optic nerve are confined in a narrow space, resulting in a clinical picture which varies according to the etiologic factor and the extent of the involvement.

Chiasmal arachnoiditis

Dr. William A. MacPherson said that this woman was first seen in the eye department on July 5, 1939, complaining of rapid loss of vision and occasional headaches; onset three weeks before. Vis-

ual acuity: R.E. 20/30; L.E. light perception. The right fundus was normal, but the left disc was pale and the vessels contracted. The peripheral field of the right eye showed a sharply demarcated temporal hemianopsia. Otherwise the findings were negative.

Because of a positive blood Wassermann, the patient was placed on antisyphilitic therapy, potassium iodide by mouth, and bismuth injections intramuscularly. However, after three weeks, the peripheral field of the right eye was found to be slightly smaller. The patient was hospitalized and given vitamin B_1 in the form of Betalin-S, 1 tablet three times daily. General neurologic examination showed no further localizing signs; the spinal-fluid Wassermann reaction was negative, and X-ray studies of the sellar region showed no bony erosion. However, because of the rapid progressive unexplained loss of vision, an exploratory craniotomy was performed on August 25th, on the service of Dr. Loyal Davis. A thick, tough, opaque arachnoid membrane was found, surrounding the optic chiasm and optic nerves as completely as possible.

At this time, two months after operation, vision: L.E. detection of hand movements in the inferior temporal quadrant; R.E. 20/13. The peripheral field in the right eye is now 60 degrees in the inferior temporal quadrant, and 20 degrees in the superior temporal quadrant. The optic disc of the left eye is now very white; that of the right appears normal.

Operative intervention in this case is probably responsible not only for halting the progress of optic atrophy in the right eye, but also for the marked improvement in central and peripheral vision.

Buphthalmos (two cases)

Dr. Clifford Sullivan said that Dr. Gifford believed iridencleisis to be the operation of choice in this condition.

The baby, nine months of age, was operated on at Passavant Hospital one month ago. Prior to operation the tension in both eyes was 65 mm. Hg (Schiötz). Following surgery, on several occasions the tension has remained at about 30 mm. The left eye had begun to show changes in Descemet's membrane, opacities of linear shape, and these symptoms led the mother to seek medical care. Both corneae were larger than normal.

The other patient, three years of age, had been treated in the same manner for a unilateral buphthalmos three years ago at the age of five months. The tension was 72 mm. Hg, and the cornea showed a dewy opacity in addition to a striation of Descemet's membrane. The tension has remained normal since operation.

Aseptic cavernous-sinus thrombosis; orbital cellulitis; serous tenonitis, tentative diagnoses

Dr. George P. Kaplan presented L. N., a white woman, who was admitted to Cook County Hospital on September 12, 1939, with bilateral proptosis and severe chemosis of three weeks' duration. Four upper incisor teeth had been extracted four weeks prior to admission. One week following the dental extraction, the right side of the face became somewhat swollen and discolored. At the same time, the right eye became red and slightly protuberant. One week after the appearance of symptoms in the right eye, the left eye became similarly involved. The discoloration of the right side of the face had, in the meantime, subsided. One week prior to admission to the hospital, or three weeks after the extraction of the teeth, both eyes became more prominent and swollen.

At the time of admission the findings were as follows: bilateral proptosis, with exophthalmometer readings, R.E. 28, L.E. 31.

The right eye showed moderate chemo-

sis of the bulbar conjunctiva; extraocular movements were limited to 10 degrees in all directions. There were a slight decrease in depth of the anterior chamber, and a few spokelike opacities in the anterior cortex of the lens. The fundus findings were normal. Vision was 0.3, corrected by +1.25 D.sph. ⊂⊃ +0.50 D.cyl. ax. 115° to 0.4. Tension (Schiötz) was 38 mm. Hg. The central form field showed concentric contraction to 10 degrees in both eyes.

X-ray studies of the skull showed clouding of the left frontal sinus, but no pathology was found. X-rays of the orbits were negative. Lumbar puncture yielded a clear spinal fluid under normal pressure, which resulted in a 2+ Pandy test, 7 cells, and a negative spinal Wassermann reaction. The blood Wassermann reaction was negative; basal metabolism −10. The neurologic examination was negative, and physical examination showed no significant findings. Blood count: 3,500,000 RBC; 7,500 WBC; hemoglobin 85 percent; differential count normal.

The patient at no time showed any evidence of sepsis. There has been a slight recession in the chemosis of the right eye, but no change in the left eye and no change in the proptosis in either eye. There has been a moderate return of extraocular motility in the right eye and to a lesser degree in the left eye. A therapeutic test with sulfanilamide was negative.

Five years at the Peiping Union Medical College

Dr. Peter C. Kronfeld presented a paper on this subject.

Syphilis of the eyes

Dr. Joseph Igersheimer (Department of Ophthalmology, University of Istanbul) presented a paper on this subject.

Discussion. Dr. Louis Bothman mentioned three interesting cases of interstitial keratitis seen in the University of Chicago Clinic in the past 18 months. Two were in patients about 40 years of age. There was no evidence of prior involvement of the cornea. He asked Dr. Igersheimer if, in his experience, the first attack of interstitial keratitis often occurs at that age. The third case was that of a boy about 19 years of age who had weathered several attacks of interstitial keratitis. He was first seen at about the age of four years. Recently he came in with a hemorrhage in the anterior chamber; three days later the cornea presented a typical picture of interstitial keratitis. Dr. Bothman said he had never seen this happen following a hemorrhage into the anterior chamber, and he wondered how often it did happen.

Dr. Joseph Igersheimer (closing) said in reply to Dr. Bothman, that he could not remember such a case. That condition must be very rare, especially if it was definitely proved to be syphilis.

In reply to Dr. Von der Heydt, he remembered several cases of patients 30 or 40 years of age with congenital syphilis. The oldest was a woman who had in one eye interstitial keratitis at the age of 12 years, and in the other eye at the age of 45. In this patient the disease was not so very mild, but it might be that in some cases it was milder than in others.

A study of cycloplegia and mydriasis by use of atropine, scopolamine, and homatropine-paredrine

Dr. James W. Marron (by invitation) read a paper on this subject which will be published in this Journal.

Discussion. Dr. Louis Bothman said that two years ago, after Dr. Beach had presented his paper before the Academy, he endeavored to compare the cycloplegic effect of combinations of Benzedrine and homatropine. The Benzedrine was a little more irritating than paredrine, but so far

as could be ascertained the action on the pupils, and the accommodation, was the same with both. The accommodation was not measured. In a summary of 29 patients (58 eyes) a comparison was made between homatropine, Benzedrine, and atropine; that is, a comparison of the refractive errors.

There were 29 patients—16 male and 13 female. Their ages were 8 to 15 years. Thirty eyes were hyperopic, 20 myopic, and 8 had mixed astigmatism.

There were 60 hyperopic meridians. In 7 meridians there was no difference between the retinoscopic findings of Benzedrine, homatropine, and atropine. In 12 there was 0.25 difference. In 13 there was 0.50. In 11 there was 0.75. In 9 there was 1.0. In 4 there was 1.25. In 1 there was 1.50. In 2 there was 2.0. In 1 there was 3.0. The average difference was 0.67 diopters.

There were 56 myopic meridians. In 12 there was no difference. In 6 there was 0.25 difference. In 19 there was 0.50. In 7 there was 0.75. In 5 there was 1.0. In 4 there was 1.25. In 1 there was 1.50. In 2 there was 1.75. The average difference was 0.52 diopters.

The axis of the astigmatism was unchanged in 26 eyes. In 32 there was an average of 25 degrees difference in the axis of the eye under the influence of the two cycloplegics.

He believed that the combination of homatropine and Benzedrine and, more recently, paredrine would give the same results as homatropine alone. Dr. Marron's study was especially interesting in that in his series the range of accommodation dropped even lower with scopolamine than with atropine.

Dr. J. E. Lebensohn asked, "If paredrine is a synergist of homatropine, what is the mechanism? How does a drug which is not itself a cycloplegic aid in the paralysis of accommodation?" In the August, 1939, issue of the Archives of Ophthalmology, Thorne and Murphey compared the use of homatropine 5 per cent, used alone and with paredrine, and found no essential difference in the depth of the resulting cycloplegia. If synergy occurred there should be a reason for it. It is understood why homatropine acts more efficiently with cocaine—the softening action of cocaine on the cornea increases the absorption of the cycloplegic drug. The sympathomimetic group (adrenalin, ephedrine, Benzedrine, paredrine, neo-synephrin) are all vasoconstrictors, and if the administration of such a drug really does increase the effective power of a cycloplegic, the vascular change in the ciliary body may be the secret of the action. Clinical experience proves that atropine relaxes accommodation much more completely in normal than in congested eyes, but even the normal under the full influence of atropine can still exercise about 1½ diopters of accommodation according to all studies on this subject. Would atropine act more profoundly if the vessels of the ciliary body were more than normally constricted? If so, it would indicate that in the study of the action of atropine, the investigators have actually measured residual accommodation, and not chromatic range, of depth of focus.

In the historical summary the essayist neglected to mention Carl Himly, who is generally credited as being the first to study extensively the action of belladonna on the eye and to popularize its use.

Robert von der Heydt.

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THE FORTY-FIFTH ANNUAL MEETING OF THE AMERICAN ACADEMY OF OPHTHALMOLOGY AND OTO-LARYNGOLOGY

No more cordial hosts nor accommodating hotel management could be found than welcomed and cared for the Academy in Cleveland. Every effort was made to render the meeting the success that it proved. Entertainment was provided for every spare moment. That means a busy pleasure program for the ladies and enough to fill in the few openings left from the society's routine for the men. Having fun is an extremely important feature of life, and the Academy has always contributed its share of this; but perhaps more than any other society its characterization is instructive —and surely that is undertaken in a businesslike manner. The courses were conducted much as usual, although there were more of the progressive-lecture type. These seemed very popular and those with whom the editor conversed who had taken some of them thought them excellent. The editor was able to take only two courses, but as always he wished that there might have been more.

Word from the correspondence courses is highly favorable. Over 300 students are enrolled. They are working hard and most

are returning very creditable papers. The task of correcting these is heavy, but the system evolved of asking different groups from month to month to handle them appears to be a good method. The courses represent a brilliant idea. Undoubtedly they will serve an important part in future ophthalmic education. The idea will surely be followed in other medical branches. The Army pointed the way years ago. Physicians now realize the application of the system to their particular needs.

The ophthalmic program was unusually good. That sentence has a familiar ring to the editor. He admits a strong prejudice for the Academy but be that as it may the programs are truly good. The joint program included two splendid papers of general interest: the first on endocrinology, and the second on allergy, both of unusual value.

The Tuesday program centered on four subjects, every one commanding attention. Dr. Kuhn's report of extensive studies on visual defects in industry was the best to date in this field. Dr. McLean's and Dr. Kronfeld's papers presented new evidence of the value of gonioscopy and left the group feeling that they must give more attention to this subject. Their papers also indicated the wisdom of paying the closest attention to the closure of corneal sections to prevent delayed re-formation of the anterior chamber. This led logically to the subject of corneoscleral sutures, which was discussed into the late afternoon; in fact, to such an hour that the evening's entertainment in the ballroom had to be delayed.

The Thursday program was only a little less meritorious than that of Tuesday, and so the audience was held by interest to the very end of the session.

The moving-picture section is decidedly a major activity. It is a method of instruction of the greatest value, and the session devoted to it is always crowded. Apropos of the closure of cataract sections, McLean illustrated his method, the unique feature of which is the linear penetration from above through half or somewhat more of the cornea at the limbus and the introduction of a suture through the lips of this wound. The thread is pulled aside and the usual section made to come out through this incision. Later tying of the suture closes the wound with exact adaptation.

On Wednesday Dr. Bedell showed more of his beautiful and instructive colored fundus photographs. That in itself is all that is necessary to make a program worth while. Many other good topics were illustrated on that afternoon.

In the teachers section the subject of undergraduate teaching was discussed briefly and inadequately. No conclusion was reached, no recommendations were made, no committees appointed to study and report on the subject. This section continues to go 'round and 'round and get nowhere.

Each year the question of a suitable meeting place becomes more acute. Only New York and Chicago can house us satisfactorily with our present set-up. The Academy constantly grows larger. Either we must go to one of these two cities, or change our system, or encounter grave difficulty. Probably no one hotel in any city will long be able to house us adequately. Because of this difficulty no decision was reached as to the location of next year's meeting. The problem is very complex; all cannot be pleased. The executive committee has listened to much discussion and will decide as wisely as possible.

The new Transactions-Bulletin of the Academy will present its first number in February. It represents a good idea and under the able editorship of Dr. Benedict and managership of Dr. Wherry is certain to be a success. An attractive format has been selected and a fine program for the

year outlined. The intention is to publish a house organ—not to compete with the current periodicals. This seems important as the Academy is so strong that excursion into the journalistic field would seriously injure existing publications.

Dr. Ralph I. Lloyd was chosen president-elect for 1942 and Dr. Frank R. Spencer for next year—good men who have been active in Academy affairs.

The pleasure of the delightful banquet was enhanced by the presence of guests from South America. Regretfully, the editor was unable to remain for the Pan-American program; it will be reported later. With the cordial spirit existing and under the leadership of the charming Dr. Alvaro of São Paulo, it could scarcely fail to have been a success.

Lawrence T. Post.

PAN-AMERICAN CONGRESS OF OPHTHALMOLOGY

If the experience of the past is any indication, it will be many years before the International Congress of Ophthalmology will be resumed. Because of the necessity for an ophthalmologic forum for the scientists of the Western Hemisphere, the American Academy of Ophthalmology and Otolaryngology sponsored and nurtured the formation of a permanent Pan-American Congress. The first meeting of this Congress was held on October 11th and 12th at Cleveland, Ohio, directly following that of the Academy. Dr. Harry S. Gradle of Chicago, who was chairman of the committee which arranged the Congress, was elected president. Seven vice-presidents from North and South America were chosen. They are Dr. S. Hanford McKee of Montreal (Canada), Dr. Frank E. Brawley of Chicago and Dr. Edward Jackson of Denver (U.S.A.), Dr. Tómas R. Yanes of Havana (Central America and the West Indies), Dr. A. Vasquez-Barrière of Montevideo, Uruguay, Dr. José Pereira Gomes of São Paulo, Brazil, and Dr. Enrique Demaria of Buenos Aires, Argentine (South America). The Congress will also have an executive council of 21, representing the 21 American republics, chosen by ophthalmologic societies or appointed by governments as the case may be.

Two executive secretaries, one to represent each of the continents, were elected. These are Dr. Conrad Berens of New York and Dr. Moacyr E. Alvaro of São Paulo, both of whom ably served with Dr. Gradle as members of the organizing committee.

It was voted to hold meetings of the Congress every three years. The next one will be held in 1943 in South America, the plac to be decided by the executive council.

The historic Cleveland meeting was well attended. The Academy members and guests who did not remain over for the Congress missed an ophthalmic treat. Iberia-America was represented by 18 of its distinguished ophthalmologists, most of whom were official delegates.

Twenty-four papers were presented. The program consisted of the titles and satisfactory abstracts in English and Spanish. As each essayist spoke, his remarks, previously translated into Spanish or English, were projected upon the screen by lantern slides and made for complete understanding of the subject discussed.

The papers were of unusually high quality and interest. Surgical procedures, optics and refraction, pathology, ophthalmoscopy, and tropical diseases were among the subjects discussed. It is difficult to select the most outstanding contributions, but the high spots were the papers on "Ocular leprosy" by de Barros of São Paulo, whose monograph on the subject is well known, "Exfoliation of the lens capsule" by Irvine of Los Angeles, "Tu-

mors of the optic nerve" by Gomes of São Paulo, "Chemotherapy in ophthalmology," by Woods and Guyton of Baltimore, and particularly the contribution of Quevado of Guatemala on "Ocular filariosis." His amazing moving picture of the female "onchocerca caecutiens" worm erupting her young, both in the egg and as microfilaria, like smoke from a chimney, will not soon be forgotten by those fortunate ones who saw it.

A dinner was held on the evening of October 11th celebrating the birth of the new society. Major General Charles R. Reynolds, president of the Association of Military Surgeons, congratulated the Congress and asserted that medical science knows no national boundaries. Many of the Latin-Americans expressed their enthusiasm for the new organization in speeches in their own tongue.

The National Society for the Prevention of Blindness was host to a luncheon on October 12th for the delegates and essayists. Mr. Lewis Carris, retired executive secretary of the society, spoke briefly on international collaboration for the prevention of blindness and introduced the Latin-Americans, who reported on the work along this line being done at present in their respective countries.

The scientific work accomplished by the first Congress needs no further comment, nor is it necessary to mention the good will, respect, and friendships fostered by it. A splendid future for the Congress is assured.

Derrick Vail.

GLAUCOMA FORTY YEARS AGO

On May 6, 1901, at the annual session of the French Society of Ophthalmology, the principal address was by de Wecker on the value of iridectomy in glaucoma. Of the several distinguished gentlemen who discussed the paper, one had been led into the room by a servant and had taken a front seat. When his turn came to speak he did not rise, but turned in his seat toward the group which silently gathered around him to listen to his low-voiced remarks. Totally blind, an operative scar on his neck, wearing dark-blue spectacles and reading with his fingers the notes he held on the table, Émile Javal dramatically exemplified the status of glaucoma therapy at the turn of the century.

Sixteen years previously a chronic glaucoma had been discovered in Javal's right eye. Posterior sclerotomy on three occasions proved ineffective, and an iridectomy was performed. All therapy was without avail, however, and the eye was lost. Premonitory symptoms had appeared in the left eye, and for 15 years the glaucomatous process in this eye had been held in check by pilocarpine. As Javal himself remarked on the occasion noted above, "Had I died at the age of 61 years (I am now 62), my case would be a classic example of the efficacy of miotics." Unfortunately the glaucoma became uncontrollable, and an iridectomy, preceded by sclerotomy, was performed by Priestley Smith. This procedure proved ineffective, as did an extirpation of the cervical sympathetic ganglion later.

As today, the classic medical treatment of glaucoma was by eserine and pilocarpine. Iridectomy had been introduced by Graefe in 1856 and, together with sclerotomy in one form or another, constituted the accepted surgical method of dealing with cases which were not controlled by drugs. Another operative procedure which enjoyed considerable favor at the time was extirpation of the cervical sympathetic ganglion, designed to produce miosis and to alter the vascular exchange of the eye. Numerous encouraging clinical reports appeared in the literature, but Lagrange

noted that after experimental cervical sympathectomy in the dog an initial hypotony was later replaced by normal tension.

A fair estimation of the conservative opinion on glaucoma therapy in those days might be summarized as follows: for acute or subacute glaucoma, iridectomy first, miotics if necessary, cervical sympathectomy if both fail; for chronic glaucoma, miotics first, iridectomy if miotics fail, cervical sympathectomy in desperate cases. It was rather generally agreed that iridectomy was effective in acute congestive glaucoma, but left much to be desired in the chronic form.

The fistulization operations came later, but it is interesting to note that Parinaud, during the same discussion of de Wecker's paper in which Javal participated, advanced his contention that the effectiveness of iridectomy resided in the establishment of filtration by incarceration of the iris pillars in the wound. Parinaud regarded a cystoid cicatrix as an advantage in controlling the pressure, although the contemporary American literature included an article noting that cystoid cicatrix following iridectomy should be regarded as a source of danger and should be treated by excision or cauterization.

The American literature of 40 years ago shows a notable scarcity of original articles on glaucoma. One contribution found is by de Schweinitz, who pleaded for the use of prophylactic iridectomy in the unaffected eye following acute glaucoma in the other eye. The majority of reports seem to have been translations or abstracts from foreign publications. Although the basic etiology of glaucoma is today scarcely less of a mystery, certainly our therapeutic armamentarium has considerably advanced, and we can offer to the patient much beyond the gloomy prospect exemplified by the unfortunate Javal.

George A. Filmer.

BOOK NOTICE

LES ASPECTS NORMAUX ET LES ANOMALIES CONGÉNITALES DU FOND DE L'OEIL (Normal aspects and congenital anomalies of the fundus oculi). By Marcel Danis, Professor of the Eye Clinic at the University of Brussels. Paperbound, 193 pages, with 38 plates in colors (outside the text) and 104 illustrations. Published for the Société Française d'Ophtalmologie by Masson & Cie, Paris, 1940. Price not stated.

Although the title page of this work indicates that it was presented to the Société Française d'Ophtalmologie on May 25, 1940, the introduction is dated December 15, 1939, and most of the work of its preparation must have antedated the active stage of the present war. At this time, it comes as a melancholy reminder of the extent to which the French and Belgian peoples have excelled in the arts of peace.

To some extent the volume is a treatise on ophthalmoscopy. Its first chapter is an interesting review of the history of ophthalmoscopy, beginning with the important observations by Mariotte and Mery in 1668 and 1704, respectively. Chapters are devoted to ophthalmoscopic technique; to ophthalmoscopy in focal and indirect illumination, and microscopy of the ocular background; and to micrometry, chromatoscopy, and retinography or photography of the ocular background. There are further important sections on anatomy and embryology. The text concludes with a rather detailed discussion of congenital anomalies of the fundus and special discussions of the fundus in the ametropias. The color plates present the almost faultless excellence with which students of this splendid French series of monographs are familiar.

W. H. Crisp.

OBITUARY

FRANCIS PARK LEWIS
1855-1940

Park Lewis, as he was generally spoken of, was born at Hamilton, Ontario, May 19, 1855. He graduated in medicine from

Francis Park Lewis

Pulte Medical College, Cincinnati, in 1876, then spent a year at the New York Ophthalmic Hospital, and received his certificate in 1877. He also studied in London, Berlin, and Vienna. Returning to this country, he took up his special practice in Buffalo, New York. He was an active member of the Buffalo Ophthalmological Club, presenting at its meetings and reporting interesting cases that had come to his notice. He became a member of the American Academy of Ophthalmology and Oto-Laryngology in 1905 and contributed to its Transactions some of his most important papers.

The presidents of that society are alternately taken from the Sections on Ophthalmology and of Otolaryngology; the first vice-president being taken from the other section. In 1911 Dr. Lewis was first vice-president of the Academy; and his address to the Section on Ophthalmology dealt with "The physical basis of our consciousness of space and time." He also read before the Academy a paper on "Ciliary processes in accommodation"; one on "Vertigo of ocular origin," and one on "Standardized case records." Other important papers were on "The hypophysis cerebri and hypothyroidism," "Focal adjustments in the aphakial eye," and "Structure of the vitreous, as studied with the slitlamp microscope."

Dr. Lewis's most important work was done in the direction of prevention of blindness. When, in 1893, he was appointed to the Board of the New York State Hospital for the Blind of Batavia, he became convinced that one-third of the blindness in that institution was preventable, he began his campaign against blindness. He started with the prevention of ophthalmia neonatorum. Based on the Credé method of prophylaxis, he agitated its general use until most of the states of the Union adopted laws requiring the use of silver nitrate, or some equally efficient prophylactic, and the reporting of cases to secure their adequate treatment. In an address on "The prevention of blindness," before the Section on Ophthalmology of the American Medical Association, he spoke of it as "practically a new science, preventive medicine." His agitation led to the formation of the National Society for the Prevention of Blindness in 1908, and of the International Association for the Prevention of Blindness in 1929, as well as the International Organization for the

Control of Trachoma. Of both organizations he was vice-president until the time of his death. On the occasion of its tenth anniversary in April, 1939, Dr. Lewis was presented with a special gold medal by the International Association for the Prevention of Blindness, meeting in London.

The Leslie Dana Gold Medal was awarded to Dr. Lewis in 1928, inscribed with the words, "for the most outstanding achievement in the prevention of blindness and conservation of vision."

He became a member of the American Ophthalmological Society in 1933. He was one of the first subscribers to the Ophthalmic Year Book, and an early supporter of the American Journal of Ophthalmology. In 1936 he became a member of the staff of the Journal, and reported the meeting of the Fifteenth International Congress at Cairo, in January of that year. At that gathering he was one of the five official delegates, representing the United States. The city of his residence also recognized him as one of her outstanding citizens when in 1933 he was awarded the chancellor's medal, an honor annually awarded to a citizen of outstanding value to the community. His death occurred on September 10, 1940. His life illustrated the highest ideal of the medical profession, practical service to mankind.

Edward Jackson.

CORRESPONDENCE

THE FUNCTION OF SUCTION INSTRUMENTS IN THE INTRACAPSULAR REMOVAL OF CATARACT

New Orleans

Dear Sir:

The removal of cataract by grasping the capsule of the lens with a small vacuum cup attached to a tube and pulling the lens from the eye seems to be making headway, at least as regards the instruments used for such a purpose. That the lens can be removed successfully by this means is granted, but the basic understanding of the instruments to accomplish this is not generally understood.

Horacio Ferrer is the last to be heard from. He has developed a Vard Hulen instrument in miniature; namely, a container from which the air has been removed by means of a pump, and a tube from the container to a cup which grasps the lens. Great praise is given Vard Hulen for his pioneer work, but since 1910 other types of instruments have been developed. Foremost is the one presented by Barraquer. This instrument may rightly be described as the meticulous instrument for cataract extraction by a vacuum grasp.

The first of these surgeons in 1910 and the last in 1940, have erred as regards the volume of vacuum required to effect the grasping of the lens. One used a five-gallon jar, another a tank with a capacity of 80 c.c. Barraquer, although he did not use a tank, used a long-drawn-out tube from a motor that may be considered an elongated tank. We must assume that these large tanks were adopted in the belief that vacuum pull was proportionate to volume, or that large volume should be created so as to allow for dissipation, the latter providing for the repeated grasping of the lens. Otherwise, they would not have handicapped themselves with either tanks or long-drawn-out tubes, when, as a matter of fact, a very infinitesimal length of tube is all that is necessary for the vacuum grasp.

A little reflection will show that there is no need for large tanks. In a vacuum the quality (ability to grasp) has nothing to do with the quantity (size of tank in which vacuum is produced), but is solely dependent upon its density. Any large volume of vacuum used for the purpose of grasping the lens may readily prove a hazard, for

when the cup breaks contact with the lens the inability of the operator to act with sufficient speed to cut off the in-rush of air through the confines of the anterior chamber and the hammering against the lens hurls the latter to the depths of the globe and destroys the eye. Therefore, large volume should not be used.

The essential requirement to accomplish a sufficient grasp is not more than the volume measurement of the cannula of the needle and the grasping cup, and a 1-c.c. syringe can readily produce the small quantity of vacuum required—approximately 0.06 c.c.

Not until 1933 was it demonstrated that the vacuum produced in a 2-c.c. syringe would provide a grasp equal if not superior to that from large tanks or long-drawn-out tubes. Furthermore, in 1937 it became known that such an instrument does not require a valve to govern the grasp on the lens; a plunger on a syringe controlled by the thumb and spring would provide an ideal make and break for the creation and dissipation of vacuum at will. The instrument developed is no larger than a fountain pen, and if the cup lost contact the quantity of vacuum the instrument created could be satisfied by the capacity of the anterior chamber, so that there need be no dread of catapulting the lens to the depth of the eye. This up-and-down movement of the plunger also makes possible the molding and vibrating of the lens, should such be desired.

The density of vacuum developed in the pen-size instrument is readily calculable. The gauge, therefore, is not required, and the sense of touch can be developed to a fine degree. Furthermore, there are no long rubber tubes to contend with. The syringe can have an even greater grasp if one minim of aqueous is used to seal the needle when the plunger is first drawn up. The smaller instrument dispenses with assistants to turn valves and care for different contraptions.

Without doubt the vacuum-grasping procedure has merit. It is quite impossible for many to purchase the equipment of Barraquer, and those who have done so dread the hammering on the lens when contact is lost. The simple syringe instrument with a precision fit of the plunger in the barrel is within the reach of all surgeons. However simple the mechanism is, it has not made it possible for any great number of surgeons to surmount the difficulty of removing the lens in capsule.

A reversal to the pioneer instruments, even though smaller than the original with its many objections, is not an advance in ophthalmic surgery, but a turn backward. Nor is any erisiphake instrument requiring a valve an advancement, when it is well known that valves can only function when grease or oil is applied, and such grease or oil may prove to be most objectionable. The great advance is to realize that a small vacuum under the control of a plunger does all if not more than tanks and valves.

Yours truly,
(Signed) Theodore J. Dimitry.

ABSTRACT DEPARTMENT

EDITED BY DR. WILLIAM H. CRISP

ASSISTED BY DR. GEORGE A. FILMER

Abstracts are classified under the divisions listed below, which broadly correspond to those formerly used in the Ophthalmic Year Book. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. General methods of diagnosis
2. Therapeutics and operations
3. Physiologic optics, refraction, and color vision
4. Ocular movements
5. Conjunctiva
6. Cornea and sclera
7. Uveal tract, sympathetic disease, and aqueous humor
8. Glaucoma and ocular tension
9. Crystalline lens
10. Retina and vitreous
11. Optic nerve and toxic amblyopias
12. Visual tracts and centers
13. Eyeball and orbit
14. Eyelids and lacrimal apparatus
15. Tumors
16. Injuries
17. Systemic diseases and parasites
18. Hygiene, sociology, education, and history
19. Anatomy, embryology, and comparative ophthalmology

10

RETINA AND VITREOUS

Borley, W. E. **Shortening of the eyeball for retinal detachment.** Arch. of Ophth., 1940, v. 23, June, pp. 1181-1187.

Lindner's modification of Müller's operative procedure for shortening of the eyeball by scleral excision is described, together with the indications, complications, and results in six cases which are reported here. Three of the cases of detachment occurred in myopic persons, two in juvenile patients, and one in a senile subject. Two of the three myopic detachments were definitely improved. The others either remained the same or slowly became worse. Cases of myopia with detachment or those in which marked retraction or shrinkage of the vitreous is suspected appear to offer the best prognosis after the shortening operation, particularly if no hole is found or if the common operations for detachment which are always done first have not brought about improvement. Lindner recently has limited the use of the operation to cases of aphakia with detachment. The steps in the operation are shown in drawings.

J. Hewitt Judd.

Brown, E. V. L. **Retroretinal tissue from the choroid in Kuhnt-Junius degeneration of the macula.** Arch. of Ophth., 1940, v. 23, June, pp. 1157-1168. (See Section 7, Uveal tract, sympathetic disease, and aqueous humor.)

Cohen, Martin. **Chorioretinal arteriolar necrosis in malignant hypertension.** Arch. of Ophth., 1940, v. 23, May, pp. 1052-1059.

After a brief discussion of the fundus changes in essential and malignant hypertension in both the moderate and severe forms, the case of a negro aged 40 years presenting the severe form of malignant hypertension is reported. The diagnosis was based on ophthalmoscopic, clinical, and microscopic observations of chorioretinal arteriolar necrosis. The histologic study of serial sections of the eyes and other organs

is essential for the detection of any degenerative vascular lesion. In this case it was demonstrated that arteriolar necrosis of the retina and choroid may occur in the absence of similar vascular changes in the kidney or in any other organ. (Color plates, discussion.)

J. Hewitt Judd.

Coppez, L. **Detachment of the choroid following operation for detachment of the retina.** Bull. Soc. Belge d'Opht., 1940, no. 79, p. 154.

Operation for detachment of the retina was performed three days after sudden failure of vision. The patient, 65 years old, had had an intracapsular cataract extraction performed two years previously on the same eye, with a particularly broad iridectomy. The operation for detachment of the retina followed the method of surface diathermy coagulation without puncture or any sort of perforation of the globe. A choroidal detachment following the operation was probably not caused by a retrochoroidal hemorrhage, for no trace of blood could be seen in the vitreous. The detachment seemed to be exudative. Jerome B. Thomas.

Davis, W. T., and Sheppard, E. **Gyrate atrophy of the retina and choroid following retinitis pigmentosa.** Arch. of Ophth., 1940, v. 23, June, pp. 1252-1256.

The literature on gyrate atrophy of the retina and choroid is reviewed, and the cases of two siblings of consanguineous parents are reported in which the diagnosis of retinitis pigmentosa was made; six years later atrophic changes were noted, and eleven years later a diagnosis of gyrate atrophy of the retina and choroid was made. The characteristic features were reduced visual acuity, night blindness, contracted fields, progressive atrophy of the retina and choroid, and complicating cataract. These cases lend strong support to the possible association of retinitis pigmentosa and gyrate atrophy, and apparently are going to progress to the point that they will simulate the appearance of choroideremia. The appearance of the fundus is shown in a color plate and fundus photographs.

J. Hewitt Judd.

Dubash, M. M. A. **Surgical treatment of detachment of the retina.** Proc. All-India Ophth. Soc., 1938, v. 6, pp. 140-148.

The author notes that the usually accepted theory of the essential lesion in detachment of the retina is a tear or hole and that closure of the tear or hole by surgical means is followed in 60 percent of the cases by a cure of the condition. Early operation is urged and the various surgical methods are discussed.

Lawrence G. Dunlap.

Fritz, A. **Results obtained in the treatment of disturbances of the retinal circulation.** Bull. Soc. Belge d'Opht., 1940, no. 79, p. 25.

To be effective, treatment of the retinal circulation should not be limited to that of the general circulatory disturbance which often accompanies retinal disease. It should be local in order to act upon the vascular elements of the retina which are undoubtedly sluggish. Most cases of retinal edema are connected with the state of the local circulation. Such cases of edema disappear after treatment reëstablishes the normal course of the blood. Retinal exudates are by no means incurable, no matter how dense they may appear to be. Diffuse exudates disappear as well as the star-shaped ones surrounding the macula. Finally, treatments of the ret-

inal circulation are capable of preventing the reappearance of retinal hemorrhages where they have occurred repeatedly, and of causing the absorption of hemorrhagic extravasations which have already occurred. (Case reports, 38 photographs of the fundus oculi, 17 references).

Jerome B. Thomas.

Jaeger, de, and Coppez, L. **Retinal detachment accompanied by acute sclerochoroiditis.** Bull. Soc. Belge d'Opht., 1940, no. 79, p. 103.

A woman 58 years old had suffered from eye trouble since childhood. Her left eye was removed because of acute pain and hypertension; the eye was blind, the globe exophthalmic. Examination revealed a complete retinal detachment. About one month later the patient returned complaining of the right eye, which was irritated and red but not painful. Five days later the eye had become painful, exophthalmos had developed, and the retina was found to be completely detached. Treatment consisted of hot compresses, daily administration of potassium iodide by mouth, and intravenous injections of atophanyl. The authors state that at the time of the report the vitreous, which had completely disappeared at the time of the retinal detachment, had been reproduced without any serious visible change. It is surprising that a retina which had not functioned over a long period and had been crumpled like the material of a closed parasol could resume its functions. However the macular function was not reëstablished. The etiology was obscure but was probably connected with some rheumatoid condition, judging by the family and personal history.

Jerome B. Thomas.

Kerly, M., and Bourne, M. **Glycolysis in retinal extracts.** Biochem. Jour., 1940, v. 34, April, p. 563.

Cell-free extracts of retina convert both glucose and glycogen into lactic acid, but glucose is more readily attacked. The same activators and coenzymes are necessary for both substrates, and the same enzyme poisons which inhibit glycogenolysis in muscle extracts also prevent glycolysis of both glycogen and glucose in retinal extracts. The intermediary reactions have not been worked out, but the results suggest that phosphorylation and concurrent oxido-reduction of intermediary products are essential reactions in the breakdown of glucose.

Edna M. Reynolds.

Koller, T., and Meyer, G. **The meaning of ophthalmoscopy in kidney diseases of pregnancy.** Schweizer med. Woch., 1939, v. 69, Dec., p. 1117.

The authors examined ophthalmoscopically 33 patients suffering from kidney disease during pregnancy. They decided that with positive fundus findings the maternal mortality was two or three times greater than in the absence of such findings; and that where the mother had preëclampsia and chronic nephritis the infant mortality was two to five times greater than normal.

Theodore M. Shapira.

Kouretas, D., and Djacos, C., **Exaggerated reflex activity of carotid sinus with epileptic attacks and spasm of the retinal arteries in a case of obliteration of carotid and subclavian arteries.** Ann. d'Ocul., 1940, v. 177, April, pp. 161-177.

A unique case in which slow obliteration of the carotid and subclavian arteries permitted development of collateral circulation from the internal

mammary and vertebral arteries. From the ophthalmologic point of view the principal feature of interest was complete retinal arterial spasm with each attack of epileptiform convulsion. The authors conclude that this is complete proof that epileptiform seizures are brought about by cerebral arterial spasm. Similar spasms were precipitated by external pressure in the region of the carotid sinus and by sudden flexion of the head.

John M. McLean.

Magitot, A., and Dubois-Poulsen, A. **Harada's disease.** Ann. d'Ocul., 1940, v. 177, April, pp. 145-160. (See Section 7, Uveal tract, sympathetic disease, and aqueous humor.)

Magitot and Lenoir. **Anatomo-pathologic studies on an eye affected by partial retinal detachment for twenty days.** Bull. Soc. d'Opht. de Paris. 1938, Jan., p. 34.

A 35-year-old woman spontaneously developed a partial retinal separation in an emmetropic eye. Tumor was suspected and the eye was enucleated, but no neoplasm was found. A complete pathologic description of the ocular tissues is presented.

George A. Filmer.

Maumenee, A. E. **Retinal lesions in lupus erythematosus.** Amer. Jour. Ophth., 1940, v. 23, Sept., pp. 971-981.

Moehlig, R. C., and Pino, R. H. **Retinitis pigmentosa; etiologic and clinical implications based on twenty-one cases.** Arch. of Ophth., 1940, v. 23, June, pp. 1257-1273.

This report is based on the study of 21 cases of retinitis pigmentosa with special reference to the part played by pituitary dysfunction. All the patients had a high arched palate. It is pointed out that, since the pituitary gland develops from the ectoderm in the roof of the mouth, it would be involved in an abnormal development of the latter structure. Tallness, migraine, hirsutism, kyphosis, and a high percentage of adenomatous goiters are other findings indicating a hyperactive gland. Actual proof of the association would require studies of the hormone in the blood and such studies cannot be made at the present time. However, the findings offered support the argument that the pituitary gland is involved in retinitis pigmentosa. J. Hewitt Judd.

Saha, K. **A case of recurrent hemorrhage in retina and vitreous in a young adult.** Proc. All-India Ophth. Soc., 1938, v. 6, pp. 130-133.

The author discusses Eales's disease, noting that the onset may occur suddenly, and that under purgatives, calcium iodide, and diaphoretic and diuretic mixtures the hemorrhages may clear rapidly in a few weeks. The hemorrhages always occur along a dilation of the inferior temporal veins and leave slight or no scars with no evidence of perivasculitis. Tuberculosis is practically always present and tuberculin treatment always indicated. The many theories as to the cause of the disease are also considered.

Lawrence G. Dunlap.

Santoni, Armando. **The metabolism of the amino acids in the retina.** Rassegna Ital. d'Ottal., 1940, v. 9, Jan.-Feb., p. 81.

Using the direct method of Warburg the author studied the influence of amino acids upon the respiration of the retina in rabbit and ox eyes. Glutamic acid produced a marked increase of the respiratory value in the retina of both animals. Santoni discusses the

general significance of the facts observed and their importance to the metabolism of the tissue. A brief review is given of the results of research upon the metabolism of the retina and particularly to aphosphoric glycolysis, which seems to be the principal result of the breaking down of the retinal tissue. (One figure.)

Eugene M. Blake.

Shlossberg, F. R., and Prizer, M. **Retinal changes with marked impairment of vision in measles.** Amer. Jour. of Ophth., 1940, v. 23, Sept., pp. 998-1000.

Starostuk, E. M. **The rapidity of regeneration of visual purple and the maximum light sensitivity of the various portions of the retina.** Viestnik Opht., 1940, v. 16, pt. 4, p. 255.

The objective of this investigation was the determination of the sensitivity of the retina beyond 26° in the horizontal diameter and beyond 20° in the other diameters, and the rate of regeneration of visual purple. The tabulated data show a decided variation in the retinal sensitivity in different persons, and in the same person. The speed of regeneration of visual purple is practically constant for the entire retina.

Ray K. Daily.

Theodore, F. H., and Ziporkes, J. **Congenital retinal fold.** Arch. of Ophth., 1940, v. 23, June, pp. 1188-1197.

Four cases are reported in which rather typical congenital retinal folds were observed. These folds are often bilateral, and, if so, are symmetric and usually directed inferotemporally. The folds are usually bordered by a heavy line of pigment and considerable pigment is scattered over the remainder of the fundus. The retina otherwise is abnormal and the macula poorly developed. The vascular distribution of the retina is abnormal, and if the fold comes forward the lens is cataractous. Other congenital abnormalities occur frequently, especially persistent pupillary membrane. Vision is markedly impaired and nystagmus is present. There is a superficial resemblance to retinitis proliferans. Several folds may be present in the same eye, and some may originate away from the disc. The folds are apparently formed as a result of adhesions between the retina and the mesoderm of the anterior half of the eye. An abnormal adhesion of the primary vitreous to the inner layer of the optic cup does not separate as the secondary vitreous appears, but results in a pulling up of the retina in a narrow tent-like detachment.

J. Hewitt Judd.

Thomas, Charles. **Retinal vascular pressure in general medicine, and in ocular pathology.** Bull. Soc. d'Opht. de Paris, 1938, May, p. 248.

The author reviews the principal physiologic and pathologic modifications of retinal vascular pressure, and urges more extensive use of Bailliart's method of measuring this pressure. Its importance in the diagnosis of increased intracranial pressure, in the prognosis and treatment of general hypertension, and in the detection of various intracranial complications is noted.

George A. Filmer.

Torres Estrada, A. **Nonsurgical treatment of retinal detachment.** Boletin del Hosp. Oft. de Ntra. Sra. de la Luz, 1940, March-April, v. 1, p. 45.

The author has recurred to compression, as recommended years ago by Freytag, Uhthoff, and others. At first using a firmly applied pressure

bandage, he later resorted to a small cushion of rubber sponge, shaped to the oculopalpebral region. It is contended that this tends to reapply the retina to the choroid. It is removed daily for instillation of atropine. After five to eight days the eye frequently shows signs of intolerance, and the bandage is then removed for a few days, the patient still being kept at rest. Four illustrative cases are described, all of them having been kept under observation for a prolonged period since cure was established (four to six years). The first patient was a myopic woman of 49 years, and the vision of the eye, which had fallen to perception of light and shadows, was restored to 0.5, and ultimately, after operation three years later for cataract, to 0.8.

The second patient, a highly myopic woman of 43 years, gained in vision from 1/15 to 0.25, suffered a relapse after a fire alarm some weeks later, but again obtained a reattachment under the compression treatment. The third patient, 56 years old, had a slight myopia; the fourth, 66 years old, had a high myopia. In this last case a plaster-of-Paris dressing was employed, and was well tolerated for ten days, after which the like pressure was intermittently used for three months, with final vision of 0.3.

W. H. Crisp.

Yanes, T. R. **Avitaminosis with respect to vitamin A—its clinical determination.** Rev. Cubana de Oto-Neuro-Oft., 1939, v. 8, May-Aug., p. 55. (See Amer. Jour. Ophth., 1940, v. 23, April, p. 478.)

Zanen, J., and Govaerts, J. **Sympathectomy and denervation of the carotid sinus in a case of pigmentary retinitis.** Bull. Soc. Belge d'Opht., 1940, no. 79, p. 75.

The first operation, on the right side, consisted of a pericarotid sympathectomy with excision of the intercarotid ganglion and nerve of Hering. Immediately following this intervention an appreciable peripheral hypertension was manifested lasting about three days. The retinal arterial tension, after a slight fall followed by a slight rise, returned rapidly to normal. There was no change in the appearance of the retinal vessels, Horner's syndrome was not observed, and the visual acuity and visual fields remained unchanged. As the results were completely negative it was decided to repeat the operation on the left side extending it by excision of the middle cervical ganglion. It was hoped thus to suppress the vasoconstrictive fibers and bring about a maximal vasodilatation. The results of this operation were also negative; at no time was the least degree of vasodilatation obtained. In view of favorable results of this treatment reported by Magitot and others, the authors are inclined to attribute their failure to the age of the vascular lesions and consequent sclerosis of the vessel walls. The authors suggest that before undertaking the operations described above, it might be helpful to perform a physiologic and temporary section of the cervical chain by anesthesia of the stellate ganglion. The result of such treatment would help one to decide whether or not the operation would be justified. (6 illustrations.)

Jerome B. Thomas.

Zitovskii, M. L. **Therapeutic aspiration of vitreous, after Zur Nedden.** Viestnik Opht., 1940, v. 16, pts. 2-3, p. 136.

A report of 13 cases in which this procedure was used with good results. It was very gratifying in recurrent

vitreous hemorrhage, for which condition the operation should be done in the later stages of the disease when the vitreous is somewhat liquid. In extensive secondary changes the operation was ineffective. In serous choroiditis with vitreous opacities without involvement of the anterior ocular segment it was helpful. In traumatic glaucoma this procedure, like posterior sclerotomy, was only of transient benefit.

Ray K. Daily.

11

OPTIC NERVE AND TOXIC AMBLYOPIAS

Borsello, G. **Annular scotoma in affections of the optic nerve.** Rassegna Ital. d'Ottal., 1940, v. 9, Jan.-Feb., p. 101.

While ring scotomata are not rare in other conditions, they are seldom described in connection with affections of the optic nerve or pathways. When present they often show an absolutely regular and symmetrical form, sometimes unchanged for long periods, and at other times showing rapid change. Peripheral concentric contraction may coexist with the annular scotoma. Annular scotomata have been observed in cerebral affections, head injuries, and after dazzling by light in aviators; also in hereditary optic neuritis, multiple sclerosis, and encephalitis, and even in normal individuals. Borsello reports three personally studied cases and believes that in these the affection of the optic-nerve fibers resulted from an arachnoiditis, chronic sinusitis being the primary cause in two of the cases. An extensive review of the literature is given. (12 figures.)

Eugene M. Blake.

Cordes, F. C. **Congenital and acquired anomalies of the optic disc.** Arch. of Ophth., 1940, v. 23, May, pp. 1063-1089.

This review includes a discussion of the normal disc and its anomalies, injuries, tumors, and diseases, including tuberculosis. The various conditions described are illustrated by photographs from Wilmer's Atlas.

J. Hewitt Judd.

Epstein, S. H. **Pathogenesis of syphilitic optic atrophy.** Amer. Jour. Path., 1940, v. 16, March, p. 157.

The author presents a preliminary study of the pathogenesis of syphilitic optic atrophy, and gives a clinical and anatomic correlation between the ophthalmoscopic signs and the distribution of the pathologic lesion in the optic pathways. The position of the nasal fibers on the meningeal surface of the optic tract makes them liable to inflammation, and this may explain the bitemporal hemianopsia found in some cases of syphilitic optic atrophy.

Theodore M. Shapira.

Hambresin, L., and Schepens, C. **Three families affected with optic neuritis.** Bull. Soc. Belge d'Opht., 1940, no. 79, p. 115.

The authors present the clinical histories of three families affected with optic neuritis, followed by certain considerations on the diagnosis, etiology, and pathogenesis of the familial affection. The optic neuritis was accompanied by central scotoma of slow development. Two families were probably affected with Leber's disease; definite diagnosis was not established for the third family but a provisional diagnosis was offered of partial familial optic atrophy due to lesions near the chiasm. The authors emphasize the importance of a thorough examination of patients affected with retrobulbar neu-

ritis, including a study of the family history. One must be on guard particularly against a hasty diagnosis of tobacco amblyopia. Two members of the families described above had been victims of such a mistaken diagnosis and had submitted to complete abstinence from tobacco over a period of years during which the vision continued to fall. (5 figures, 3 genealogic trees, 54 references.)

Jerome B. Thomas.

Jackson, Edward. **Cerebellar hemangioblastoma.** Amer. Jour. Ophth., 1940, v. 23, Sept., pp. 1038-1039.

Roschin, V. P. **Histopathology of a gumma in the orbit and optic nerve.** Viestnik Opht., 1940, v. 16, pts. 2-3, p. 118. (See Section 13, Eyeball and orbit.)

Weatherby, F. E., and Wiley, N. H. **Left-sided weakness, blood pressure difference between the two arms and left optic atrophy: a new clinical syndrome?** Jour. Nerv. and Mental Dis., 1940, v. 92, Aug., p. 151.

A case presenting the above symptoms is reported in detail. There was primary optic atrophy on the left side with only doubtful atrophy on the right side (moderate pallor of temporal half of the disc). The blood pressure in the right arm averaged 160/80, while by the auscultatory method the blood pressure in the left arm was 0/0. The systolic pressure in the left arm was estimated by palpation to be from 92 to 97. There was slight weakness of the muscles of the left side of the face and numbness in the left arm and leg. The patient had a constant tendency to stagger and fall to the left and the left leg was cold at all times. There was weakness of the left hand grip. There was no record or history of syphilis and both blood and spinal fluid were repeatedly negative. General arteriosclerosis and renal failure to concentrate were present. X-ray examinations showed no abnormality of the aortic arch or intrathoracic tumor. The possibility of left-sided peripheral vascular disease or trophic disturbances resulting from disease of the central nervous system is suggested as causing the condition. Edna M. Reynolds.

12

VISUAL TRACTS AND CENTERS

Gupte, V. V. **Homonymous hemianopsia in diabetes.** Proc. All-India Ophth. Soc., 1938, v. 6, pp. 162-164.

Gupte reports hemianopsia in two men of 45 and 55 years respectively. Examination was negative except for diabetes. The author could find accounts of only 23 such cases in the medical literature. He believes the condition is caused by vascular lesions in the occipital lobes, that it is usually permanent, and that it may be followed by hemiplegia. In all cases which came to autopsy the lesions were vascular (hemorrhagic) in character.

Lawrence G. Dunlap.

13

EYEBALL AND ORBIT

Donahue, H. C. **Acute serous tenonitis.** Amer. Jour. Ophth., 1940, v. 23, Aug., pp. 917-920.

Roschin, V. P. **Histopathology of a gumma in the orbit and optic nerve.** Viestnik Opht., 1940, v. 16, pts. 2-3, p. 118.

A woman fifty years old came to the Eye Institute with exophthalmos of the left eye, ocular immobility, choked disc, and retinal hemorrhages. Negative Wassermann and Mantoux reac-

tions, continued progress of the exophthalmos under antiluetic therapy, absence of periostitis, and uncertain biopsy findings led to the diagnosis of a malignant tumor and subsequent exenteration of the orbit. Microscopic sections of the removed tissue proved it to be a gumma of the orbit. The central retinal vessels in the optic nerve were unchanged, but in the region of the optic papilla there were definite signs of endovasculitis with endothelial proliferation. Ray K. Daily.

Rychener, R. O. **A simple technique for glass-ball implantation following enucleation of the eyeball.** Southern Surgeon, 1940, v. 9, May, pp. 321-327.

The author describes in detail a technique for enucleation of the eyeball, with glass-ball implantation in Tenon's capsule. He stresses the following points: the use of glass balls with a maximum diameter of 18 mm., a purse-string chromic catgut suture in Tenon's capsule, and a pressure bandage for 72 hours following operation.

T. E. Sanders.

Sugar, H. S., and Meyer, S. J. **Pulsating exophthalmos.** Arch. of Ophth., 1940, v. 23, June, pp. 1288-1321; also Trans. Amer. Acad. Ophth. and Otolaryng., 1939, 44th mtg., p. 166.

The literature since 1930 is reviewed and 165 cases added to those previously summarized, together with the authors' six cases. The mechanism of origin of true pulsating exophthalmos, the clinical picture of pulsating exophthalmos due to carotid-cavernous aneurysm, the appearance of glaucoma in pulsating exophthalmos, and the diagnosis of this condition are considered. The six cases include four due to carotid-cavernous communication, one due to orbital arteriovenous aneurysm, and one of pseudopulsating exophthalmos, due to orbital angioma. Treatment, whether surgical or nonsurgical, depends upon two factors: (1) the prevention of short-circuiting of blood into the venous system, and (2) a decrease of intracranial pressure for a sufficient length of time to promote thrombosis. The authors advocate first rest and compression with observation of vision and general condition, and then partial or total ligation of the common carotid artery. Later the superior thyroid or external carotid artery can be dealt with if necessary. High-voltage roentgen therapy was not tried. (Discussion, bibliography.) J. Hewitt Judd.

Van Canneyt, J. **Microphthalmos of one eye, coloboma of the choroid of the other (second case in the same family).** Bull. Soc. Belge d'Opht., 1940, no. 79, p. 100.

A case report with historic data on heredity. (One chart, 2 photographs.)

Weekers, L., Fanconnier, H., and Joiris, P. **Orbital prothesis.** Bull. Soc. Belge d'Opht., 1940, no. 79, p. 66.

The authors report in detail the preparation of an orbital prothesis for use by a patient with deformity due to extensive exenteration of the orbit. (3 illustrations.) Jerome B. Thomas.

14

EYELIDS AND LACRIMAL APPARATUS

Bursuk, G. G. **Canthoplasty.** Viestnik Opht., 1940, v. 16, pt. 4, p. 243.

Bursuk describes a method for lengthening the palpebral fissure in cases of old trachoma. The principal feature is the stretching of the lid border with the lashes to the length of the new palpebral fissure. (Illustrations.) Ray K. Daily.

Dejean, C., and Portal, J. **Lateral insertion of the nasolacrimal duct on**

the lacrimal sac. Bull. Soc. d'Opht. de Paris, 1938, May, p. 195.

In a patient complaining of epiphora, fluid could be syringed into the nose but a probe could not be passed. Lipiodol X-rays showed the nasolacrimal duct to arise from the side of the sac instead of from the bottom.

George A. Filmer.

Hadley, H. G. **Dermatolysis palpebrarum (blepharochalasis).** Rocky Mountain Med. Jour., 1940, v. 37, July, pp. 517-519.

A case report.

Keyton, J. A. **Treatment of chronic dacryocystitis: a new technique.** Jour. Med. Assoc. State of Alabama, 1940, v. 9, April, pp. 342-343.

Over a period of eight years, the following treatment of chronic dacryocystitis has been found very useful. The canal is dilated with an ordinary Bowman dilator until a no. 3 or 4 will pass readily into the inferior meatus. A silver probe threaded with six or eight strands of ordinary no. 40 sewing thread is passed through the dilated canal into the nose. The thread is then brought out of the nose and tied to the other end. It is left in the canal for three or four weeks, being drawn back and forth daily. A mild antiseptic such as 2-percent mercurochrome may be passed down along the thread. If the nasal end of the canal cannot be dilated, equally good results may be obtained by passing the probe out through the ethmoids between the inferior and middle turbinates with manipulation as described above. T. E. Sanders.

Oleson, J. J., Elvehjem, C. A., and Hart, E. B. **Spectacled eye condition in rats.** Proc. Soc. Exper. Biol. and Med., 1940, v. 43, Jan., p. 161.

A deficiency disease in rats characterized by erosions of the lids is termed "spectacled eye condition" because of its appearance. The feeding of corn oil had remarkable curative properties. Fuller's-earth filtrate of liver extract was also active although the cures were slower than with corn oil. Direct and indirect evidence is offered that the factor concerned is not identical with pantothenic acid, factor W, or the factor preventing nutritional achromotrichia. John C. Long.

Torres Estrada, A. **Simplification of the classical technique for external dacryocystorhinostomy.** Boletin del Hosp. Oft. de Ntra. Sra. de la Luz, 1940, May-June, pp. 69-96.

With an abundance of illustrations, the author describes a modification of technique, which is especially designed to overcome the difficulty of inserting deep sutures in the Dupuy-Dutemps operation. This difficulty is due to the depth and narrowness of the operative space, as well as to the tendency for hemorrhage to obscure the field. The author overcomes the difficulty by inserting his sutures through the nose with a long needle-like instrument, curved near its tip and with the hole near the tip (somewhat like an aneurysm needle). After the sac has been separated from the bony wall, the usual window into the nose is made with chisel, hammer, and biting forceps. After passing a sound into the sac, the latter is slit vertically. The special needle is carried up in the nose beneath the bridge of the nose, and is carried through the nasal mucosa at the junction of the middle and lower thirds of the trephine opening, one end of the suture being drawn through the opening. The position of the special needle

is then changed so as to permit of the needle being passed through the mucous membrane at the junction of the middle and upper thirds of the trephine opening, and the other end of the suture is drawn through the opening. The nasal mucosa is incised from the external side, to form a semi-oval extending along the upper, anterior, and lower borders of the trephine opening. With a small straight "Reverdin" needle, previously plunged through the skin and deeper tissues from above the upper lid, and passed behind the sac, the upper stitch which has been passed through the semi-oval flap of the nasal mucosa is picked up and drawn out through the tissues on to the skin surface. The same procedure is then followed with the lower part of the suture, passing the "Reverdin" needle through the skin and deeper tissues and behind the sac, from below the lower lid. The special intranasal needle, rethreaded, is then directed through the nasal mucosa a little in front of the anterior edge of the trephine opening, and is carried obliquely backward through that opening, at a position corresponding to that of one of the ends of the suture which was previously passed through the semi-oval flap of the mucosa. A second stitch is passed from the nose 4 mm. from the anterior margin of the nasal mucosa lying at the anterior border of the trephine opening. These two sutures continue through the anterior margin of the vertical slit in the sac. When these four suture ends are carefully tied, the sac has been placed in communication with the interior of the nose.

The author claims that the results obtained by this easier technique for insertion of the sutures have been very greatly superior to those obtained with older methods. W. H. Crisp.

Yanes, T. R. **Paradoxic monocular ptosis.** Arch. of Ophth., 1940, v. 23, June, pp. 1169-1172.

A man aged 39 years presented an incomplete paralysis of the left third nerve with involvement of the extrinsic muscles and preservation of the pupillary movements. The eye was in a position of forced abduction and the upper lid drooped so as to nearly occlude the eye. The ptosis was not absolute, but disappeared completely upon occlusion of the right eye, and when this eye was directed outward or inward. There was a history of acquired syphilis, and probably a nuclear lesion. The anomaly persisted after surgical treatment.

J. Hewitt Judd.

Yris, J. M. **A case of leishmaniosis americana in the eyelid.** Boletin del Hosp. Oft de Ntra. Sra. de la Luz, 1940, March-April, v. 1, p. 65.

The patient, a woman of 22 years, had slept several nights in the tropical woods. The lesion began with itching, followed by swelling and gradual ulceration. Seen a year after onset, the ulcer, 3 or 4 mm. deep, had a semicircular shape and extended from the palpebral fissure to below the lid area. The neighboring skin was healthy, and the yellowish covering of the bottom of the ulcer resembled a false membrane, which gave off a yellowish discharge. A scraping showed no fungi, and no leishmania, but did contain diplococci, which are often encountered in association with leishmania. The latter is often absent from old ulcers. In addition to local treatment, the patient was given intravenous injections of a 0.5-percent solution of tartar emetic (double tartrate of potassium and antimony). The first dose of 2 c.c. producing no reaction, on the fourth day an

injection of 4 c.c. was given. In the afternoon of the same day a high temperature developed, for which an injection of 1 gm. of quinine hydrochloride was given on the fifth and again on the sixth day. Eight c.c. of the tartrate was injected on the seventh day. By this time the ulcer was healing rapidly. Larger injections of the tartrate were continued every day for a number of weeks, with rest intervals.

W. H. Crisp.

15
TUMORS

Beery, E. N. **Melanosarcoma of choroid.** Arch. of Ophth., 1940, v. 23, June, pp. 1213-1215.

A man aged 66 years presented a lobular mass, approximately 3 by 3 cm. in size, completely filling the interpalpebral fissure and posteriorly contracted into a thick stalk, passing intraocularly. It appeared that the growth had originated from within the eyeball and had pushed through at the corneoscleral juncture to replace the anterior chamber and cornea. Histologically, it was found that the eye had been completely destroyed and replaced by actively growing tumor tissues except near the equator where a 1-cm. strip of sclera was found with remnants of uveal tissue and glass membrane. The tumor was characteristic of melanosarcoma with mixed content of spindle and polyhedral cells. (Photographs.)

J. Hewitt Judd.

Bonnet, P., and Colrat, A. **Tumor of the optic nerve.** Bull. Soc. d'Opht. de Paris, 1938, Jan., p. 51.

A clinical and histologic description of an optic-nerve tumor removed from a two-year-old child.

George A. Filmer.

Claes, Elsa. **Congenital tumor (dermoid) of the sclerocorneal limbus.** Bull. Soc. Belge d'Opht., 1940, no. 79, p. 88.

Clinical and pathologic report of a case of dermoid of the limbus. (2 photomicrographs of tumor sections, 3 references.) Jerome B. Thomas.

Desvignes, P., and Brigeat, P. **Tumor of the region of the inferior canaliculus.** Bull. Soc. d'Opht. de Paris, 1938, Dec., p. 590.

A pea-sized tumor of the lower lid had the clinical appearance of an intracanalicular adenoma. Pathologic examination showed it to be a nonpigmented nevus. George A. Filmer.

Gery, L., and Milaras, T. **Two cases of stratified-layer epithelioma in children.** Bull. Soc. d'Opht. de Paris, 1938, May, p. 282.

An epithelioma of the lid was seen in a child of ten years, and one of the conjunctiva in a child of four. Pathologic descriptions are given. (Illustrations.)

George A. Filmer.

Green, R., Goodlow, R., Evans, C., Peyton, W., and Titrud, L. **Transmission of a human papilloma to monkeys.** Amer. Jour. Cancer, 1940, v. 39, June, p. 161.

Inoculation of the eyes of three monkeys with a suspension of human papilloma resulted in tumor formation at the site of inoculation in all three cases. The authors conclude that this is highly suggestive of the presence of an infectious agent in the human papilloma.

T. M. Shapira.

Kulvin, M. M. **Metastatic carcinoma of choroid with primary focus in the prostate gland.** Amer. Jour. Ophth., 1940, v. 23, Aug., pp. 892-899.

Luo, T. H. **Conjunctival lesions in tuberous sclerosis.** Amer. Jour. Ophth., 1940, v. 23, Sept., pp. 1029-1034.

Machlin, I. M. **Neurofibromatosis of the iris.** Viestnik Opht., 1940, v. 16, pt. 4, p. 216.

A report of a case in which biomicroscopy showed that both irides were infiltrated with numerous round yellow nodules, projecting slightly forward. There was no disturbance of function.

Ray K. Daily.

Nanavati, B. P. **Three cases of dermoid of the conjunctiva associated with other ocular conditions.** Proc. All-India Ophth. Soc., 1938, v. 6, pp. 90-94.

Certain types of tumor of the conjunctiva occur in conjunction with other types. During the previous ten years 103 new growths of the conjunctiva were recorded in one hospital (71 granulomas, 12 dermoids, 11 malignancies, and 9 papillomas). This report deals with two cases of dermoid associated with subconjunctival dermolipoma or nevus, and a third case of multiple dermoids. The occurrence of dermoid is fairly common, but the association of dermoid with either dermolipoma or nevus in the same eye is very unusual. In none of the cases could growth of hair from the dermoids be seen, and all of the tumors (under slit-lamp study) were found to be situated in the superficial layers of the cornea.

Lawrence G. Dunlap.

Nordmann, Jean. **Nerve tumors of the ciliary body and iris.** Bull. Soc. d'Opht. de Paris, 1938, May, p. 300.

The author describes two ciliary-body and iris tumors which had the appearance of the meningoblastomas usually seen in the choroid near the optic disc.

George A. Filmer.

Pokrovskii, A. I. **Dermoids of the orbit.** Viestnik Opht., 1940, v. 16, pt. 4, p. 199.

The author reviews the literature and reports the case of a woman 28 years old. The dermoid was removed through a simple orbitotomy and was found closely connected with the lacrimal gland, part of which was removed with the tumor. Because of the importance of removing the growth in toto the author believes that for deep-seated tumors the Krönlein operation is the procedure of choice.

Ray K. Daily.

Tarlau, M., and McGrath, H. **Pathological changes in the fundus oculi in tuberous sclerosis.** Jour. Nerv. and Mental Dis., 1940, v. 92, July, p. 22.

The authors report a case of tuberous sclerosis in an Italian woman. The patient was retarded during infancy and at the age of five years was recognized as a mental defective. At the age of 16 years she developed convulsive seizures. She was under hospital observation from November, 1934, until her death in April, 1938, at the age of 23 years. The fundi were entirely normal on admission to the hospital but in February, 1938, the upper portion of the left disc was found obscured by an overlying mass about 2 disc diameters in size. The mass did not increase in size from the time it was first noticed. After the patient's death a detailed microscopic study was made of the left eye. A tumor mass was found overlying the superior portion of the optic disc and adjacent retina. The optic nerve and nerve-fiber layer of the retina were invaded. Histologic study showed the tumor to be an astroblastic neoplasm of low-growth possibilities.

John C. Long.

Wibo, M. **New treatment of dermoid of the cornea: excision diathermy coagulation.** Bull. Soc. Belge d'Opht., 1940, no. 79, p. 55.

The writer claims for his combined operation remarkably good cosmetic results and appreciable improvement in vision. Jerome B. Thomas.

16
INJURIES

Aliquó-Mazzei, Alessandro. **Traumatic ruptures of the retina without detachment, healed spontaneously.** Boll. d'Ocul., 1939, v. 17, April, pp. 263-269.

Two cases are reported. The first was in a man of twenty years, who received a number of gunshot wounds, including three by shot which passed through the eyeball from the temporal toward the nasal side. After three months the resulting retinal tears had healed without retinal detachment and with complete restoration of vision. The second patient was a boy of 14 years. His left eye was penetrated by a bullet which remained in the ocular wall 6 or 7 mm. from the limbus at the three o'clock position. Upon removal of the bullet, the lips of the corneal wounds were sutured. Absorption of the large hemorrhage in the vitreous was extremely slow, but vision was 10/10 at the end of nine months. In neither case did detachment of the retina occur. Aliquó-Mazzei cites a number of authors who have pointed out that even nontraumatic ruptures of the retina, complicated by detachment, may heal spontaneously. W. H. Crisp.

Bothman, Louis. **Glaucoma following irradiation.** Arch. of Ophth., 1940, v. 23, June, pp. 1198-1212; also Trans. Amer. Acad. Ophth. and Otolaryng., 1939, 44th mtg., p. 199. (See Section 8, Glaucoma and ocular tension.)

Cruise, R. R. **A visor for the prevention of war blindness.** Brit. Med. Jour., 1940, May 18, p. 825.

Most cases of war blindness result from penetration of the eyes by small particles, usually metallic. Between 1914 and 1918 approximately 2,000 persons were blinded in both eyes and 40,000 were blinded in one. The author has invented a protective visor which he believes would have prevented over half of the cases of blindness in the last war. It consists essentially of a perforated sheet of duraluminum molded to fit the inner curvatures of a steel helmet. A spring adjustment facilitates easy lowering when necessary. (3 photographs.) John C. Long.

Dautrebande, L. **Ophthalmologic aspects of gases used in warfare.** Bull. Soc. Belge d'Opht., 1940, no. 79, p. 159.

Dautrebande is a recognized authority on the use of gas in warfare. The first half of his address is devoted to a classification of the various gases and vapors, their chemical constituents and general effects; the second half enters into a consideration of the effects of these toxic gases on the eyes. He classifies the lacrimogenic gases in two groups, the essentials and the accidentals. The former are solely lacrimogenic and produce tears by irritation of the ocular mucosa without causing definite lesions. The accidental lacrimogens consist of aggressive particles which attack the skin or lungs as vesicants or anoxemiants respectively, but which also produce lacrimogenic effects, incidentally but effectively. In this latter class are included chloropicrine and yperite (mustard gas). The ocular effects of yperite are well known, the

characteristic vesication of the eyes often progressing to ulceration of the cornea. The last category of poisons described consists of the aerosols which, although they do not produce direct irritation of the ocular mucosa, cause perhaps the most constant lacrimogenic effects of all the poisons used in warfare. They produce tearing, not by direct irritation but by a reflex accompanied by sneezing, coughing, or vomiting. As it is difficult to protect the individual against these poisonous vapors by gas masks, the aerosols probably constitute the most effective of the lacrimogens. (3 figures.)

Jerome B. Thomas.

Duggan, P. J. **Disturbance of accommodation following the use of valerian.** Irish Jour. Med. Science, 1940, v. 172, April, p. 180.

The author reports a case of weakness of accommodation following the use for one month of a home-made extract of valerian. The accommodation was normal one week after discontinuing the drug. T. E. Sanders.

Fritz, A. **Shells for treatment of ocular burns.** Bull. Soc. Belge d'Opht., 1940, no. 79, p. 149.

The prothesis used for insertion between globe and lids bears in its center an orifice into which ointment tubes may be screwed and medicated ointments squeezed between globe and lids without removing the prothesis. Lavage may be practised in the same way.

Jerome B. Thomas.

Genet, L. **Copying ink projected on to the conjunctiva. Conjunctival lymphatics in biomicroscopy.** Bull. Soc. d'Opht. de Paris, 1938, Jan., p. 44.

In a case of accidental entrance of ink into the conjunctival sac, the conjunctival lymphatics transporting the ink could be examined with the biomicroscope. George A. Filmer.

Krasnov, M. L. **The effect of weakly magnetic steel on the eye.** Viestnik Opht., 1940, v. 16, pt. 4, p. 237.

This is a laboratory study on animals to determine the extent of siderosis and inflammation produced by injuries from the various steel alloys now used in industry. Fragments of these alloys were introduced into various parts of the animals' eyes, and after completion of the clinical course, which varied from three to twenty months, the eyes were enucleated and examined histologically. The findings show that the rustless steels with a high content of chromium or nickel do not produce siderosis. Among the steel alloys on the market are easily corrosive products which cause siderosis as easily as ordinary steel, noncorrosive products which do not cause siderosis, and products which produce an insignificant amount of siderosis. The local inflammatory reaction is present in injury from any type of metal, but the reaction is more pronounced in the presence of easily oxidized metal. Around ordinary steel one sees the development of a connective-tissue capsule; the presence of rustless metal leads in the anterior chamber to a proliferation of the endothelium, and in the vitreous to a proliferation of glial tissue. Detachment of the retina was found about twice as frequently in injuries from corrosive metals as in those from the rustless types. Ray K. Daily.

Krasnov, M. L., and Sozortzeva, P. M. **Investigations on chinolin no. 31, a new antimalarial preparation.** Viestnik Opht., 1940, v. 16, pt. 3, p. 218. (See Section 2, Therapeutics and operations.)

Morgan, O. G. **Some cases of traumatic myopia.** Brit. Jour. Ophth., 1940, v. 24, Aug., pp. 403-406.

Four types of traumatic myopia are described: ciliary spasm, partial rupture of the fibers of the suspensory ligament of the lens accompanied by iridodonesis, trauma to the lens itself, and serious damage to the anterior or posterior coats of the eye.

D. F. Harbridge.

Narucci, Luigi. **Experimental ocular lesions caused by yprite. Effects of short-wave therapy.** Rassegna Ital. d'Ottal., 1940, v. 9, Jan.-Feb., p. 56.

Yprite produces not only local necrotizing effects similar to those resulting from high temperatures or X ray, but also general symptoms from damage to various organs by toxins. The ocular lesions induced by yprite are varied and as severe as those produced by any of the war gases. The author induced damage to the eyes of 24 rabbits for the purpose of testing short-wave therapy. He describes the changes occurring in the eyes and concludes that short-wave therapy has no value in experimentally induced lesions. (22 figures.)

Eugene M. Blake.

Neame, Humphrey. **Multiple ruptures of choroid with retention of good vision.** Brit. Jour. Ophth., 1940, v. 24, Aug., pp. 399-400.

A young man aged 19 years suffered a blow on the left eye, causing multiple ruptures of the choroid. In one month he was able to resume his work. The condition is fully described, a chart being presented. The case was unique in that it did not show the damage to central vision usually seen with rupture of the choroid. D. F. Harbridge.

Traquair, H. M. **Perimetry and the visual pathway.** Glasgow Med. Jour., 1940, v. 133, April, pp. 105-118.

In the Mackenzie Memorial Lecture for 1939 before the Royal Faculty of Physicians and Surgeons of Glasgow, the author outlines the present status of perimetry, stressing the localization of lesions at the various levels in the optic pathway by their field defects.

T. E. Sanders.

17

SYSTEMIC DISEASES AND PARASITES

Argañaraz, Raul. **Ocular anaphylaxis and allergy.** Arch. de Oft. de Buenos Aires, 1939, v. 14, May, p. 356.

This is the second installment of a comprehensive treatise on allergic conditions in ophthalmology (see Amer. Jour. Ophth., 1940, v. 23, p. 847). The author, after making some general observations on ocular allergy, passes to a detailed consideration of allergic conjunctivitis, including drug allergies, hay fever, and spring catarrh. He also discusses anaphylactic parenchymatous keratitis, phlyctenular disease, sympathetic ophthalmia, and phacoanaphylactic uveitis. As diagnostic aids, patch tests, intradermal injections, and conjunctival and intranasal topical applications are mentioned.

Edward P. Burch.

Barber, F., and McNamara, J. J. **Clinical report on eye lesions due to nasal sinus infections.** New York State Jour. Med., 1940, v. 40, May 1, p. 720.

The authors report nine cases in which the eye lesions cleared up after treatment of the underlying sinus infections. Theodore M. Shapira.

Billimoria, N. P. **The treatment of herpes zoster ophthalmicus.** Proc. All-

India Ophth. Soc., 1938, v. 6, pp. 156-160.

The author divides herpes zoster into two forms, epidemic and symptomatic; in the course of herpes zoster ophthalmicus he notes two stages, one consisting of the skin lesion only, and the second showing ocular manifestations. Intravenous injections of sodium iodide (2 grams in 20 c.c. of distilled water) on the first, second, fourth, and seventh days, and one or two subcutaneous injections of 0.5 c.c. of pituitrin, together with vitamin B_1 intramuscularly and milk injections for the corneal complications, are recommended. The Walker treatment with diphtheria antitoxin has also given excellent results.

Lawrence G. Dunlap.

Feldstein, G. J. **Amaurotic family idiocy.** Pennsylvania Med. Jour., 1940, v. 43, June, p. 1296.

The author presents briefly a case of amaurotic idiocy and includes discussion of two more cases. One fundus photograph is included.

Theodore M. Shapira.

Kluever, H. C. **Hyperuricemia and inflammations of the eye.** Amer. Jour. Ophth., 1940, v. 23, Aug., pp. 867-872.

Sindhu, P. S. **Herpes zoster ophthalmicus with unusual complications.** Proc. All-Indian Ophth. Soc., 1938, v. 6, pp. 149-155.

A description is given of typical herpes zoster ophthalmicus, its symptoms and appearance. Note is made of its frequent occurrence with chickenpox, although neither disease confers immunity to the other. Ocular complications or sequelae arise in approximately one half of the cases. The most common ocular complications are: conjunctivitis, keratitis, iridocyclitis, ocular palsies, and optic neuritis. The recently proposed treatment with sodium iodide intravenously, followed twelve hours later by one c.c. of pituitrin given subcutaneously and repeated for two or three days, is advised.

Lawrence G. Dunlap.

Stokes, W. H. **Ocular manifestations in hydroa vacciniforme.** Arch. of Ophth., 1940, v. 23, June, pp. 1131-1145.

A review is made of the clinical characteristics and manifestations of hydroa vacciniforme, together with the ocular complications previously reported in the literature. Two cases in which corneal complications occurred are reported with descriptions of the lesions as seen with the slitlamp, and the histologic findings in a section of conjunctiva removed for microscopic study. The clinical apearance of the lesions and the histologic changes are illustrated with photographs.

J. Hewitt Judd.

Thau, W. **The effect of reducing diets on the eye.** Canadian Med. Jour., 1940, v. 42, June, p. 550.

Five cases of ocular disturbance resulting from faulty diet are reported. Two cases of xerophthalmia and one of phlyctenula are attributed to vitamin-A deficiency. A young women with subconjunctival suffusions and bleeding of the gums improved on a balanced diet with high vitamin-C intake. There is a general discussion of the relationship of vitamins to the eye.

John C. Long.

Yanes, T. R. **Avitaminosis with respect to vitamin A—its clinical determination.** Rev. Cubana de Oto-Neuro-Oft., 1939, v. 8, May-Aug., p. 55. (See Section 10, Retina and vitreous.)

18

HYGIENE, SOCIOLOGY, EDUCATION, AND HISTORY

Alexandrov, V. V. **The examination of ocular function in marine engineers.** Viestnik Opht., 1940, v. 16, pts. 2-3, p. 162.

In order to determine the relation between failure to observe traffic signals and color blindness, 27 engineers who violated signal rules were examined. Only three showed defects of color vision. Samoilov calls attention to color asthenopia, which he believes is the most widespread color defect, and which can be detected only with the Nagel anomaloscope; people with color asthenopia should be considered unfit for occupations involving signal recognition. The majority of the 27 signal-violators attributed their failure to recognize the signal to factors such as sun glare, fog, rapid change in illumination, and inaccurate judgment of distance. The latter clearly indicates inadequacy of depth perception, and the author urges that candidates for transport-engineering positions be given tests for depth perception in addition to tests for binocular vision. Corneal opacities and anisometropia cause inadequacy of depth perception, which may be overlooked if depth perception is not tested. Ray K. Daily.

Berens, Conrad. **Statistics relating to blindness.** Amer. Jour. Ophth., 1940, v. 23, Aug., pp. 915-917.

Gallino, J. A. **Sight-saving schools.** Arch. de Oft de Buenos Aires, 1939, v. 14, May, p. 380.

The writer makes a plea for more comprehensive care of the visually handicapped child in Argentina and advocates a census of the blind.

Edward P. Burch.

Gupta, M. K. **Program for "eyesight preservation day" in schools.** Proc. All-India Ophth. Soc., 1938, v. 6, pp. 169-176.

The usual eyesight-preservation program in schools is recommended and the setting aside of a special "eyesight-preservation" day is urged. Cards should be filled out including the notation of such conditions as eyestrain, cross-eyes, headache, unnatural weariness, head tilting, squinting, and photophobia. Follow-ups are urged.

Lawrence G. Dunlap.

Jackson, Edward. **Historic notes on ophthalmoscopy.** Amer. Jour. Ophth., 1940, v. 23, Aug., pp. 873-876; also Trans. Amer. Ophth. Soc., 1939, v. 37, p. 282.

This is a statistical study of 3,993 blind pupils in 39 schools. Tabulations are made of the etiologic classification, site and type of affection, amount of vision remaining, age distribution, and age at onset of blindness.

Kerby, C. E., and McKay, E. C. **Eye conditions among pupils in schools for the blind, 1937-1938.** Outlook for the Blind, 1939, v. 33, Dec., p. 140.

John C. Long.

Khautin, C. M. **The limits of heterophoria consistent with admission into aëronautic schools.** Viestnik Opht., 1940, v. 16, pts. 2-3, p. 148.

This investigation sought to determine the effect of horizontal heterophoria on some ocular functions. Of 1,500 young men with not less than 0.8 visual acuity, 38 percent had orthophoria, 32 percent esophoria, and 30 percent exophoria. The part of heterophoria not caused by anatomic variations was inconstant, and depended on the refraction, the tonus of the ocular muscles, and the general physiologic

and emotional state. Heterophoria is not necessarily associated with muscular asthenopia, in which the general condition is also a factor. A distance heterophoria of 4° does not cause any disturbance in depth perception, and the presence of heterophoria should not be interpreted as an inadequacy in any ocular function. The elimination of a candidate because of horizontal heterophoria is not justified.

Ray K. Daily.

Lavery, F. S. **Trachoma in Ireland.** Trans. Ophth. Soc. United Kingdom, 1939, v. 59, pt. 2, p. 850.

The figures obtained as a result of the inspection of two blind asylums and many records of the blind would indicate that trachoma is responsible for 9 percent of the blindness in Ireland. After considerable trial the author concluded that sulphanilamide was useless in the treatment of trachoma.

Beulah Cushman.

Lavos, George. **Special licenses for the handicapped under state minimum wage laws.** Outlook for the Blind, 1940, v. 34, Feb., p. 6.

The advance of social legislation into new fields has in general decreased the occupational possibilities for the handicapped. Minimum-wage laws might have a disastrous effect on the employment of handicapped people were it not for special licensing provisions. These provisions enable a handicapped person to work for a wage less than the legal minimum if his handicap is such as to decrease his productive ability. There is a discussion of the application of the provisions in various states and recommendations for future legislation. The author suggests that the state make up the difference between the substandard wage and the minimum wage to the end that the minimum standards of living be attainable to all members of society.

John C. Long.

Lebensohn, J. E. **Ophthalmology in Illinois.** Illinois Med. Jour., 1940, v. 77, May, p. 480.

An excellent historical essay.

T. M. Shapira.

Löhlein, Walther. **Memorial speech on Albrecht von Graefe and Jules Gonin on the occasion of the bestowal of the von Graefe medal.** Graefe's Arch., 1939, v. 141, pts. 2 and 3, pp. 125-138.

The author presents a summary of the lives and achievements of Graefe and Gonin in connection with the posthumous award of the Graefe medal to Gonin, renowned for his pioneer work on detachment of the retina. The coveted honor was turned over to Edouard Gonin, the son of Jules Gonin, and to Amsler, his pupil and successor. (This speech was to have been delivered at the meeting of the German Ophthalmologic Society on September 4, 1939. The gathering did not take place because of the outbreak of war.)

Charles A. Perera.

Maxwell, Euphan. **Preventive ophthalmology in Eire—a critical survey.** Irish Jour. Med. Science, 1940, v. 173, May, p. 201.

The methods undertaken to preserve vision are discussed in relation to four age-groups. Children in the preschool group are aided under the provisions of the Maternity and Child Welfare Act. School children should have improved classroom illumination. The value of special schools for "partially-sighted" children has not been definitely established; instead the author

suggests larger type and more oral teaching. The discussion of sight-saving for the adult group deals largely with safety factors in industry. Certain aspects of public health administration are discussed. Official ophthalmologists have been appointed for every county, with the exception of Dublin and Cork where well-equipped eye centers already exist. John C. Long.

Nicholls, J. V. V. **A survey of the ophthalmic conditions among rural school children.** Canadian Med. Jour., 1940, v. 42, June, p. 553.

A visual survey was made of all children in the schools visited, 521 children between the ages of five and twenty years being examined. Children showing any abnormality of vision or extraocular movements were refracted under cycloplegia. Inflammatory conditions and developmental defects were very uncommon. It was found that 29.7 percent of the children had defective vision from one cause or another. Myopia was present in 9.4 percent of the series (4.6 percent of the boys and 13.4 percent of the girls). No cases of myopia were found under the age of nine years. Glasses were indicated in 12.8 percent of the children, about half of whom were already wearing them. The data are well summarized in five tables.
John C. Long.

Preobrazshenskaja, M. H. **The new registration of trachoma.** Viestnik Opht., 1940, v. 16, pts. 2-3, p. 173.

A detailed interpretation of the new regulations relative to registration of cases. Ray K. Daily.

Rafalovich, C. H. **The rationale of forbidding the use of corrective lenses among railroad workers.** Viestnik Opht., 1940, v. 16, pts. 2-3, p. 168.

The author urges revision of existing regulations which forbid the use of corrective lenses for railroad engineers, and at the same time reduce the required visual acuity with years of experience. The author believes that the low visual acuity, while complying with regulations, is inadequate for work requirements. The invention of a coating which prevents the lenses from becoming steamy eliminates the chief objection to the use of corrective lenses. Ray K. Daily.

Taborisky, J. **Trachoma in Northern and Southern Russia and in Palestine.** Rev. Internat. du Trachome, 1939, Oct., v. 16, p. 201.

During 36 years of experience with various nationalities in Europe and Palestine, the author has observed no difference in the clinical picture of trachoma. J. Wesley McKinney.

Vakker, A. G. **Trachoma in the Unterwald canton.** Viestnik Opht., 1940, v. 16, pt. 4, p. 270.

In this Soviet republic, populated by Germans, the prevalence of trachoma before the revolution was 36 to 57 percent. This prevalence is attributed chiefly to the German custom of the entire family washing in a common basin of water. The introduction of ophthalmologic service and the education of the population in sanitary habits had reduced the prevalence of trachoma to 10 percent in 1937. Ray K. Daily.

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ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

Crozier, W. J., and Wolf, E. **Flicker response curve for fundulus.** Jour. Gen. Physiology, 1940, v. 23, July 20, p. 677.

Fundulus heteroclitus shows a rather extreme flicker-response curve because

the rod part of the curve is larger than that found in a number of other vertebrates. Edna M. Reynolds.

Crozier, W. J., and Wolf, E. **Reaction to visual flicker in the newt Triturus.** Jour. Gen. Physiology, 1940, v. 23, July 20, p. 667.

The newt Triturus viridescens (water phase) shows a flicker-response curve whose complexity suggests the presence of more than one kind of rod and cone. The curve for Triturus has much the same quantitative structure as that found with various fresh-water teleosts at the same temperature.
Edna M. Reynolds.

Crozier, W. J., and Wolf, E. **Temperature and critical illumination for reaction to flickering light. 6. Flash duration varied.** Jour. Gen. Physiology, 1940, v. 23, May 20, p. 531.

For the turtle Pseudemys scripta the temperature characteristics required to produce constant performance in the visual-reaction system were found to be independent of flash frequency, flash intensity or proportion of light time in the flash cycle. Edna M. Reynolds.

Glücksmann, A. **Development and differentiation of the tadpole eye.** Brit. Jour. Ophth., 1940, v. 24, April, pp. 153-178.

After describing the 12 morphologic stages of development of the tadpole eye, the author presents a quantitive analysis of the cell processes involved in the early development. (Graphs, figures, diagrams, references, plates and descriptions.) D. F. Harbridge.

Leplat, G. **The modern conception of the mechanism of the development of the individual, especially of the ocular apparatus.** Bull. Soc. Belge d'Opht., 1940, no. 79, p. 6.

This address reviews briefly the progress of embryology during recent years. Certain animal species possess predetermined lens cells which evolve spontaneously into a vesicle and then into lens fibers; whereas in other species the evolution of the epiblastic cells into lens elements must be provoked by the inductive action of an optic vesicle. However, this action does not seem to be mechanical, but chemical in nature. The speaker emphasizes the discovery of the inductor centers. Their chemical action diffuses among the adjacent cells which are thereby induced to evolve in a particular sense from the morphogenic centers. Concerning the nature of the organizing substance, he mentions Needham's experiments, which have led to the discovery of synthetic carbon rings estrogenic, carcinogenic, and morphogenic.
Jerome B. Thomas.

NEWS ITEMS

Edited by Dr. H. Rommel Hildreth
640 S. Kingshighway, Saint Louis

News items should reach the Editor by the twelfth of the month

Deaths

Dr. Herman Theodore Schlegel, Wausau, Wisconsin, died August 9, 1940, aged 70 years.

Dr. Wilson Randolph, Detroit, Michigan, died August 2, 1940, aged 62 years.

Dr. Bleeker James Knapp, Evansville, Indiana, died August 20, 1940, aged 63 years.

Miscellaneous

The March, 1941, issue of the Mississippi Valley Medical Journal will be that publication's fourteenth annual "Radium Number." It will follow the same general plan as in previous years —essentially practical and clinical in nature. The support of the profession to make it another success is solicited. Short papers on any phase of radium therapy, of practical interest to the general practitioner or general surgeon, are solicited. They must reach the editor, Harold Swanberg, M.D., 209-224 W.C.U. Building, Quincy, Illinois, not later than February 20, 1941.

Notice has been received from Dr. Silvio de Almeida Toledo of the organization of the service of a campaign against trachoma in the state of São Paulo, Brazil. Aiming at a complete refounding of the sanitary organization of the state, Dr. Adhemar Pereira de Barros, Federal Interventor, founded the Health Department, whose director is Dr. Humberto Pascale. Dr. de Barros also founded under the General Directory of the Technical Division the Trachoma Section among other sections and appointed Dr. Aristides Rabello to the post of technically supervising the trachoma service in the entire state of São Paulo.

The Trachoma Institute, established in the capital, is headed by the chief-physician, Dr. Plinio Caiado de Castro, and has as its aim: (a) the working out of statistics about the disease in the state; (b) scientific research on the epidemiology of trachoma in their environment; (c) the medical and surgical treatment of those affected by the disease; (d) the training of the technical staff, physicians, male and female nurses for fighting the disease; (e) organization of a specialized library, and sanitary propaganda of the prophylaxis of the disease; (f) studies of treatment methods; (g) technical guidance of the prophylaxis services realized by the trachoma dispensaries of the health-centers of the capital.

Societies

On September 24th, during the annual meeting of the Mississippi Valley Medical Society at Rock Island, Illinois, a group of medical editors from Illinois and Iowa met and organized the Mississippi Valley Medical Editors' Association. The proposed plan of organization is chiefly to exchange experiences in medical writing and editing. It is also hoped that some type of co-operating advertising bureau can be eventually formed in connection with the association that would serve smaller publications in the Middle West, in the same manner as the Co-operative Advertising Bureau of the American Medical Association serves the state journals.

Officers were elected at the organization meeting as follows: president, Dr. George B. Lake, Waukegan, Illinois, editor of Clinical Medicine; vice-president, Dr. James Dunn of Davenport, Iowa, editor of the Bulletin of the Iowa and Illinois Central District Medical Association; and secretary-treasurer, Dr. Harold Swanberg of Quincy, Illinois, editor of the Mississippi Valley Medical Journal. An executive committee was also elected as follows: Dr. F. J. Cenedella of Moline, editor of Medical-Dental News of the Quad-Cities; Dr. C. P. Dyer of Saint Louis, Missouri, editor of the Saint Louis County Medical Society Bulletin; and Dr. Florence Johnston of Cedar Rapids, Iowa, editor of the Linn County Medical Society Bulletin.

Active membership in the association is open to all ethical physicians, who are members of the American Medical Association, interested in medical journalism or writing. The association appeals particularly to editors of bulletins and journals of district and county medical societies and all other medical journals in the Mississippi Valley. The plan of the organizers is to hold an annual meeting each year in connection with the Mississippi Valley Medical Society meeting, so the association will especially appeal to medical journalists and writers from Illinois, Missouri, and Iowa but is open to all. The membership fee and first year's dues are $5.00 with annual dues of $3.00. All joining before January 1, 1941, will be known as charter members and the $5.00 fee will pay dues to January 1, 1942. Application blanks may be secured from the secretary, Dr. Harold Swanberg, 209-224, W.C.U. Building, Quincy, Illinois.

Personals

Dr. Walter B. Lancaster of Boston has been appointed chief of staff of the Dartmouth Eye Institute and assumed his new duties on November 1st. Dr. Lancaster has practiced his specialty in Boston since 1897. In addition to

his practice as consulting ophthalmic surgeon, he was an Associate in Ophthalmology at the Harvard University Medical School and Consulting Ophthalmic Surgeon at the New England Hospital for Women and Children. He relinquished this work to devote himself fully to his new post at Dartmouth.

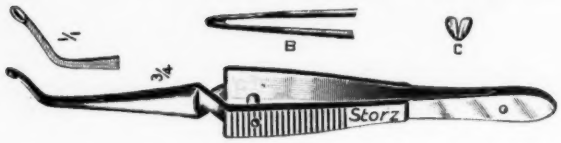
Dr. Lancaster has long specialized in the field of physiological optics and was instrumental in founding at Dartmouth the Department of Research in Physiological Optics, from which the present Dartmouth Eye Institute has grown. The college honored him in 1939 with the Doctorate of Science.

Dr. Lancaster was graduated from Harvard University in 1884, and from the Harvard Medical School in 1889. He was ophthalmic surgeon successively at the Boston City Hospital and the Massachusetts Eye and Ear Infirmary for three decades, and since 1928 has continued his work in a consulting capacity. He was formerly instructor in ophthalmology at the Harvard Medical School and has held his present associateship there since 1938.

Dr. Lancaster is past president of the American Ophthalmological Society, the American Board of Ophthalmology, the American Academy of Ophthalmology and Otolaryngology, and the New England Ophthalmological Society. As chairman of the ophthalmology section of the National Conference on Nomenclature of Disease he devised the standard naming of eye diseases, and it was he who gave the name "aniseikonia" to the disease of unequal vision for which the Dartmouth Eye Institute has discovered methods of diagnosis and treatment. During the World War he was head of the department of ophthalmology at the aeronautical research laboratories at Mitchell Field, New York, a background of experience which is expected to be of great value in the research program which the Dartmouth Eye Institute is now conducting at the Pensacola naval air base for several branches of the government air service.

Dr. Lancaster is a member of the executive committee of the Advisory Board of Medical Specialties, a Fellow of the American College of Surgeons, and a member of the American Medical Association, the Optical Society of America, the National Research Council, the American Academy for the Advancement of Science, the Illuminating Engineering Society, the Massachusetts Medical Society, and the four ophthalmological societies of which he is past president. He has published scores of learned papers in the field of physiological optics.

Dr. Lancaster has an additional tie with Dartmouth College through his wife, the former Emma Winter of Newton, Massachusetts, who is a descendant of Eleazar Wheelock, founder and first president of the college.



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